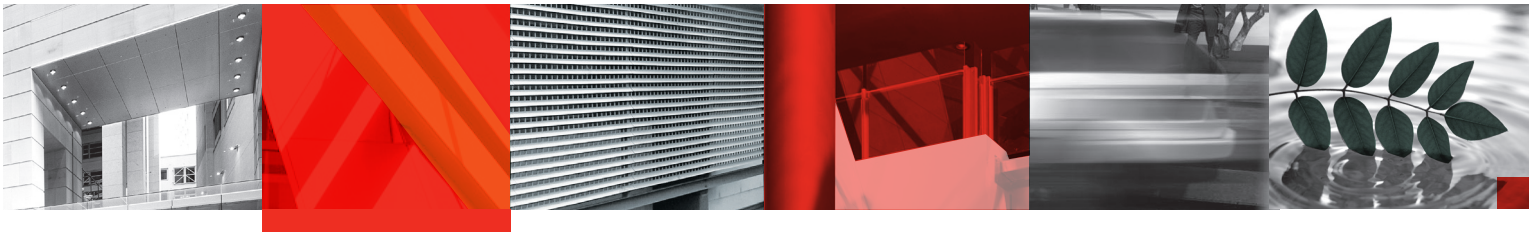
Environmental Assessment Report



North Nowra Link Road
Concept Plan

Submitted to Department of Planning
On Behalf of Shoalhaven City Council

February 2011 ▪ 10188

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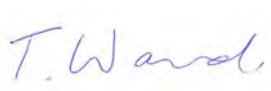
This report has been prepared by: Tim Ward



Date 11/02/2011

This report has been reviewed by: Gordon Kirkby

Date 11/02/2011

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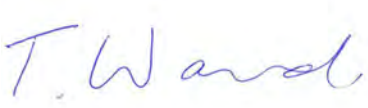
Statement of Validity

Prepared under Part 3A of the Environmental Planning and Assessment Act, 1979 (as amended)

Environmental Assessment prepared by	
Name	Tim Ward
Qualifications	BSc, MEM
Address	Level 7, 77 Berry Street, North Sydney
In respect of	a Concept Plan application for the North Nowra Link Road
Concept Plan	
Applicant name	Shoalhaven City Council
Applicant address	Bridge Road, Nowra, NSW, 2541
Land to be developed	Option1 (the Central Option): Lot 7310 DP1153421, Lot 7311 DP1153421 Lot 7312 DP1153421, Lot 152 DP751258 (POR 152) Option 2 (the Southern Option): Lot 5 DP740466, Lot 6 DP525880, Lot 7 DP525880, Part – Lot 18 DP23459, Part – Lot 17 DP23459, Lot 27 DP130999, Lot 28 DP130999, Lot 7311 DP1153421, Lot 119 DP751258 (POR 119), Lot 118 DP751258 (POR 118), Lot 7313 DP1153421, Part – Lot 151 DP751258 (POR 151). Option 3 (the Northern Option): Lot 110 DP131219, Lot 108 DP131063, Lot 109 DP3060, Lot 7311 DP1153421.
Proposed development	A North Nowra Link Road
Environmental Assessment	An Environmental Assessment (EA) is attached.
Certificate	I certify that I have prepared the content of this Environmental Assessment and to the best of my knowledge: ▪ It is in accordance with the Environmental Planning and Assessment Act and Regulation. ▪ It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.
Signature	
Name	Tim Ward
Date	11 February 2011

Executive Summary

Purpose of this report

This submission to the Department of Planning comprises an Environmental Assessment for a Concept Plan application under Part 3A of *the Environmental Planning and Assessment Act 1979* (EP& A Act). It relates to the development of the North Nowra Link Road (NNLR), being a local sub-arterial road connecting North Nowra with the Princes Highway at Bomaderry, north of the Shoalhaven River bridge crossings.

The Minister for Planning determined, by an order published in the Government Gazette, that the North Nowra Link Road was a project to which Part 3A of the EP&A Act applied. The Director General's Requirements were provided to the proponent, Shoalhaven City Council, on 3 May 2009.

This submission addresses the issues raised in the Director General's Requirements.

Overview of Project

This Concept Plan application for the North Nowra Link Road presents the outcomes of Council's investigations into the three options set out in the Minister's order for the North Nowra Link Road. The three route options that are subject of the Minister's order are shown in **Figure ES1** below.

Figure ES1: The Three NNLR Options required to be investigated under the Minister's Order

The Concept Plan application prepared for the site:

- Is seeking in-principle approval for the development of the preferred North Nowra Link Road route option, with consideration of strategic planning objectives, and to address short-medium term local road network constraints.
- Will initiate the process under the *National Parks and Wildlife Act 1974* (NPW Act) to revoke part of the Bomaderry Creek Regional Park for the purpose of the North Nowra Link Road.

The Environmental Assessment prepared to support the Concept Plan application:

- Assesses the three (3) route options specified by the Minister for Planning.
- Identifies the comparative strengths and weaknesses of the three route options specified by the Minister, and selects a preferred option which is proposed to be carried forward for detailed design.

Location and description of the Project

The North Nowra Link Road site is located between Illaroo Road, West Cambewarra Road and the Princes Highway, north of the Shoalhaven River bridge crossings in the Shoalhaven City local government area (LGA).

Each of the three (3) route options would cross several allotments under different forms of ownership. In particular:

- Option 1: The Pitt Street to Narang Road Option (known as the Central Option) would mainly cross through Crown Land and Bomaderry Creek Regional Park (which is under the care and management of the NSW Department of Environment, Climate Change and Water), Council owned land and an existing road corridor (Narang Road). Through the Regional Park and Crown Land it generally follows the alignment of an existing cleared services corridor.
- Option 2: The Illaroo Road to West Bunberra Street Option (known as the Southern Option) would mainly cross through Crown Land and Council owned land, although it would also impact on private properties adjacent to the Princes Highway and a small part of the south-eastern corner of the Bomaderry Creek Regional Park.
- Option 3: The West Cambewarra Road Option (known as the Northern Option) would mainly cross through Council owned land although it would also impact on a private property adjacent to Moss Vale Road and a small part of the north-western corner of the Bomaderry Creek Regional Park. It generally follows the alignment of West Cambewarra Road.

Statutory Planning Context

State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP) provides that development for the purposes of a road may be carried out by or on behalf of a public authority on any land without development consent except where the land is reserved under the NPW Act.

Notwithstanding this, by Order of the Minster for Planning published in the Government Gazette the North Nowra Link Road is a project to which Part 3A of the EP&A Act applies and the approval of the Minister for Planning is required under Part 3A to carry out the project.

Each of the three route options will affect land within the Bomaderry Creek Regional Park which is land that has been dedicated under the NPW Act. The project is not covered by an easement or any other existing interest in the Regional Park, and it is the policy of DECCW not to issue an authorisation for the use of the Regional Park for a new road.

As such, for the North Nowra Link Road to proceed, the relevant land will need to be revoked from within the Regional Park. It is intended that this Concept Plan application initiate the proceedings to revoke land from within the Regional Park for the NNLR.

Strategic Planning Context

The proposed North Nowra Link Road is consistent with the relevant priorities and objectives of the NSW State Plan and the South Coast Regional Strategy, with specific aims to improve overall traffic network efficiency.

The State-wide development and transport objectives have been further reflected in the Nowra Bomaderry Structure Plan (NBSP) which has been adopted by Council and endorsed by the NSW Department of Planning. The NBSP identifies that the NNLR is an integral part of the plan, because it would enhance the capacity of the existing road network and allow it to accommodate the needs of current and future residents by providing a much needed alternative route from North Nowra to the Princes Highway, alleviating pressure on the Princes Highway in the critical link across the Shoalhaven River between Bolong Road (to the north) and Bridge Road (to the south). Should the North Nowra Link Road not be provided, the feasibility of directing new growth to North Nowra, in accordance with the NBSP, could be seriously compromised.

Project Need and Objectives

The NNLR project aims to address observed and modelled constraints in the existing traffic network and provide an important element of the necessary capacity improvement to accommodate future growth as envisaged under the endorsed NBSP.

The key local traffic issues with regard to traffic in the North Nowra to Bomaderry area, as characterised from traffic modelling, which are proposed to be addressed through the NNLR are:

- Congestion at the Illaroo Road/Princes Highway Intersection.
- Congestion on Illaroo Road.

It is noted that there continues to be significant congestion on the Princes Highway, including at and around the Shoalhaven River bridges, however this is not an issue which Shoalhaven City Council propose to address through this project. The Princes Highway is a State Road and the authority principally responsible for its maintenance and operation is the NSW Roads and Traffic Authority (RTA). Notwithstanding this, the proposed NNLR is consistent and supportive of options being investigated by the RTA in regards to possible future improvements to the Princes Highway and the Shoalhaven River bridge crossings in Nowra.

Environmental Impacts

This Environmental Assessment Report (EAR) provides an assessment of the environmental impacts of the project in accordance with the Director-General's Environmental Assessment Requirements and includes a draft Statement of Commitments which sets out the undertakings made by Shoalhaven City Council to manage and minimise potential impacts arising from the development.

In particular, the EAR has carried out an environmental assessment for each of the three route options nominated in the Minister's Order, identifying the comparative benefits and impacts of the three route options. The environmental assessment also identifies the mitigation and management measures that would be carried out during the subsequent phases of design and construction.

Based on the relative strengths and weaknesses of the three route options Council has identified the following:

- The Central Option is the preferred option for the North Nowra Link Road. Overall it meets all the project objectives best of the three options, and the key biodiversity impacts can be adequately mitigated.
- The Southern Option would meet the overall project objectives fairly effectively, however it has high capital costs and carries a higher environmental risk associated with contamination issues at the former landfill site, more significant noise mitigation, acquisition of private property with similar overall biodiversity risks to the Central Option.
- The Northern Option fails to meet all project objectives with limited benefits in terms of traffic effectiveness and a net negative benefit / cost ratio. It is unlikely that Council would be able to justify the capital expenditure in the construction of the Northern Option given the net negative benefit / cost ratio.

Approval Sought

With this application Council is seeking Concept Plan approval of at least 1 route corridor, preferably the selected preferred route corridor (which is Option 1 – the Central Option), being a single road corridor nominally 30 metres wide to accommodate a new North Nowra Link Road.

If neither the Central Option nor the Southern Option were approved as part of the Concept Plan then it is unlikely that Council would pursue the Northern Option because of the outcome of preliminary findings of the impacts of the Northern Option, the negative benefit / cost associated, and the limited traffic benefits in terms of resolving traffic congestion along the existing Illaroo Road in the short, medium and long terms. Future growth plans currently envisaged under the Nowra Bomaderry Structure Plan would also have to be reassessed and this may mean that the Illaroo Road to Moss Vale Road Link Road may be at risk of not proceeding.

In terms of addressing the short-medium term issues on Illaroo Road and at the Illaroo Road / Princes Highway Intersection, if neither the Central Option nor the Southern Option were approved, Council would continue to encourage the RTA to deliver the River Crossing Relief scheme and would carry out works along Illaroo Road on a needs basis to try and address the amount of accidents occurring along Illaroo Road, noting that any treatments are likely to add further delay to motorists and would not address the underlying problems associated with high traffic volumes, poor levels of safety and amenity conditions, and the associated on-going costs to the community.

Conclusion

The NNLR will help to achieve the strategic planning objectives for Nowra, improving access between the growing area of North Nowra with the main transport route, being the Princes Highway at Bomaderry. It will also alleviate worsening traffic congestion and safety situation on Illaroo Road and helping to defer more substantive investment by the State Government in regards to the provision of extra capacity across the Shoalhaven River bridge crossings.

The Draft Statement of Commitments has been prepared to inform the detailed design of the development and manage construction and on-going environmental impacts. The environmental assessment addresses the Director General's Requirements and demonstrates the impacts of the proposal can be satisfactorily managed and therefore the Concept Plan for the Central Option for the North Nowra Link Road should be approved.

PART A
Strategic Context and Need for the Project

1.0 Introduction

The Concept Plan seeks approval for development for purposes of a new link road connecting North Nowra and the Princes Highway at Bomaderry. The concept of the proposed new road is called the North Nowra Link Road (NNLR).

This Concept Plan and Environmental Assessment Report (EAR) is submitted to the Minister for Planning pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This is to fulfil the Environmental Assessment requirements issued by the Director-General (the DGRs) for the preparation of an Environmental Assessment to support a Concept Plan application for the North Nowra Link Road (NNLR).

The Concept Plan is seeking to address strategic project issues and establish the key parameters of the development prior to more detailed design work being undertaken by the proponent, Shoalhaven City Council.

The report has been prepared by JBA Urban Planning Consultants Pty Ltd, for the proponent, Shoalhaven City Council, and is based on Concept Plan and design information provided by Shoalhaven City Council and supporting technical documents provided by the specialist consultant team.

1.1 Scope of Concept Plan and EAR

This EAR describes the site, its environs and the proposed development, and provides an assessment of the proposal in accordance with the Director-General's Requirements (DGRs) under Part 3A of the EP&A Act. It should be read in conjunction with the information contained within and appended to this report.

In particular, the EAR includes detailed investigations of the three alternative routes for the NNLR (as required and as specified by the Minister for Planning when he declared the project to be subject to Part 3A on 3 May 2009) which address the DGRs for the environmental assessment.

The three options that have been considered in detail for the North Nowra Link Road, and which are part of the Concept Plan Environmental Assessment, are described as:

- Option 1: Central Option – This option connects Pitt Street with Narang Road, generally following an existing cleared transmission line and water main services corridor across Crown Land, Council owned land and through the Bomaderry Creek Regional Park (BCRP).
- Option 2: Southern Option – This option joins Illaroo Road to the Princes Highway at West Bunberra Street, crossing Bomaderry Creek further to the south east (compared to Option 1) and following the southern boundary of the BCRP.
- Option 3: Northern Option – This option runs parallel to West Cambewarra Road (to the immediate south of West Cambewarra Road, with local access connections back to West Cambewarra Road) partly through Council owned land and partly through the northern section of the Regional Park, connecting to Moss Vale Road at Elvin Drive.

The EAR and its accompanying specialist reports provides a technical assessment of the environmental impact of the proposed development, recommend a preferred route for the NNLR, and identify proposed mitigation measures to manage potential environmental impacts associated with the proposal.

Figure 1.1 shows the original conceptual location of the three options which were subject of the Minister for Planning's Part 3A declaration, and which formed the basis for the investigations carried out as part of the Concept Plan Environmental Assessment Report. (Note: Refinements which have been made to the route options are described in detail in Section 7 of this EAR).

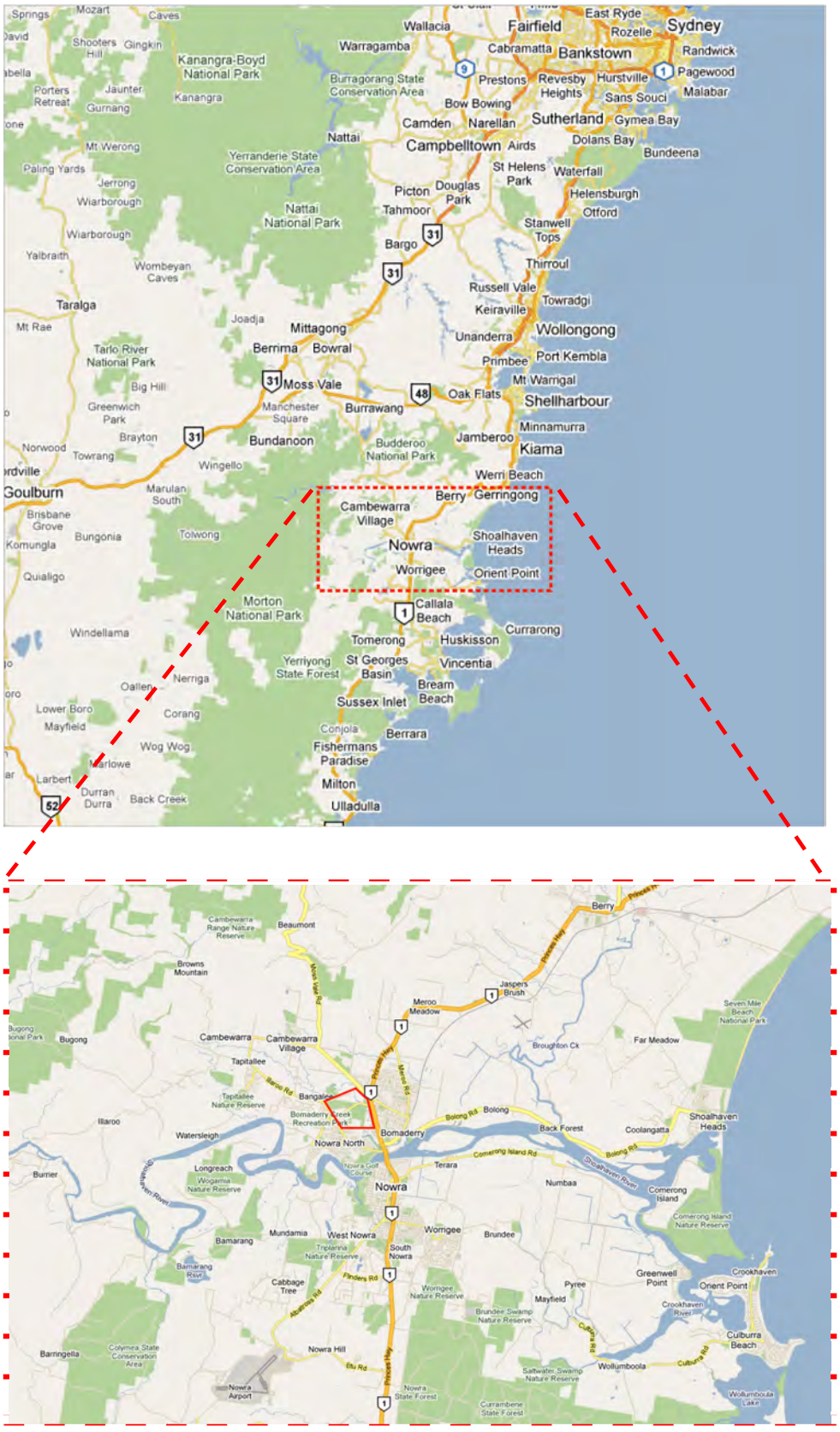
Figure 1-1: Conceptual Location of the three North Nowra Link Road Options declared by the Minister for Planning

1.2 Local and Regional Traffic Context

Plans showing the regional layout and key regional transport links as well as a locality plan and local traffic network are provided in **Figure 1.2**. The key regional transport corridor is the Princes Highway, which can be seen running north-south in **Figure 1.2** shown by route marker "1" identifying the Princes Highway as State Highway 1. Key features of the existing local traffic network are:

- The three key population centres are Bomaderry to the north-east of the existing river crossing, North Nowra to the north-west of the existing river crossing and Nowra town centre to the south-west of the existing river crossing. **Figure 1.3** shows the current and proposed urban structure of Nowra Bomaderry highlighting the 3 principal Living Areas and Neighbourhood Centres at North Nowra, Bomaderry and the Nowra CBD. It is important to note the southerly focus of both North Nowra and Bomaderry with strong desire lines to the Nowra CBD, as well as a strong desire line between North Nowra and Bomaderry due to the presence of services and jobs in Bomaderry (including high schools, commercial and industrial jobs).

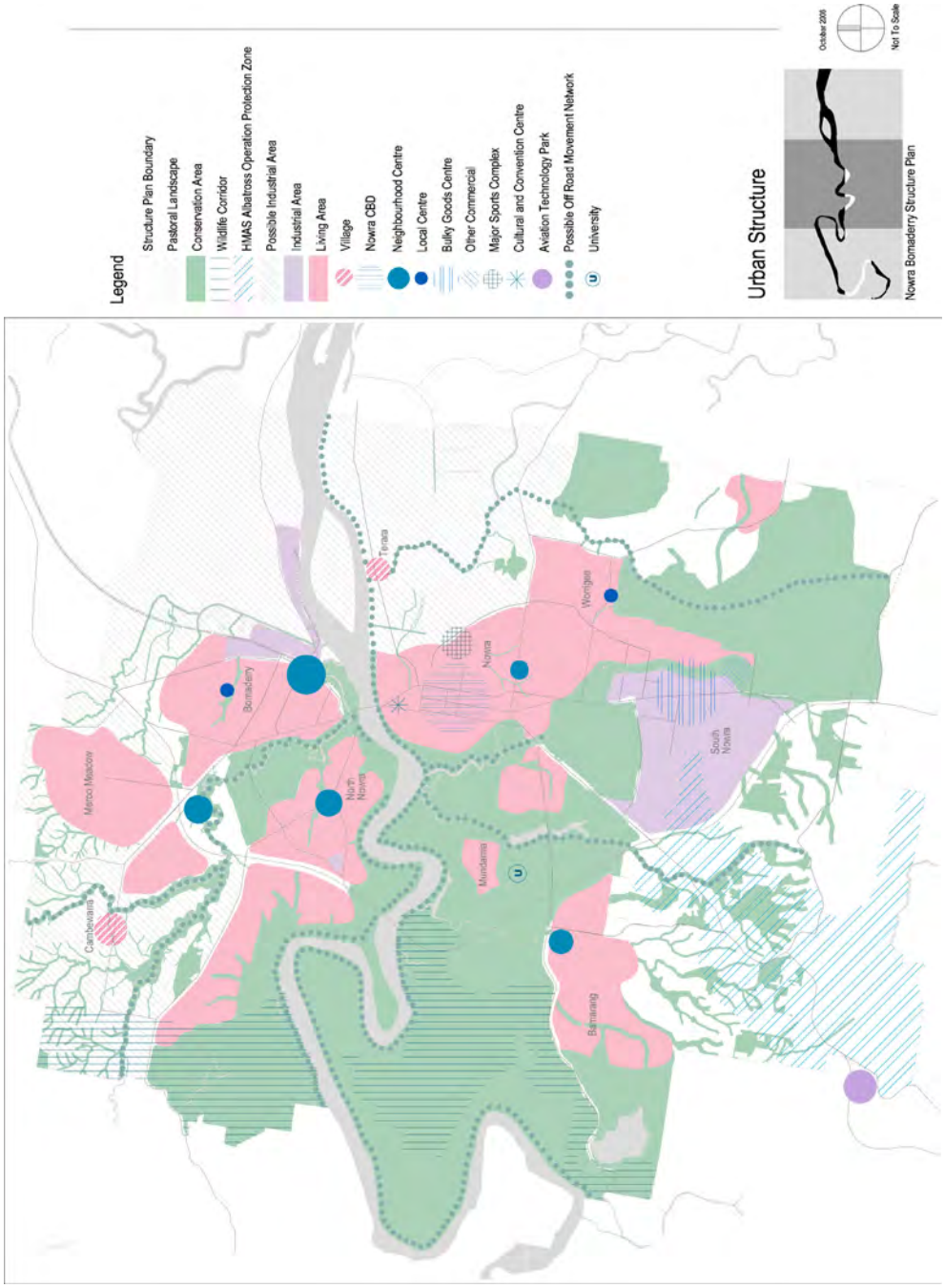
Figure 1-2: Regional and Local Context of the North Nowra Link Road



- The Princes Highway forms the dominant north south link in the network. Traffic flowing to and from the Nowra CBD from North Nowra or Bomaderry (and beyond) must all pass across the twin bridges over the Shoalhaven River. Approximately 52,200 vehicles per day cross the Shoalhaven River. Origin-destination surveys undertaken by Council in 1994 and 2003 indicate that only about five per cent of movements on the Princes Highway over the Shoalhaven River Bridge are direct through traffic (i.e. traffic that doesn't stop in Nowra/Bomaderry), the rest being locally generated or regional traffic accessing Nowra. (Council's origin-destination surveys are described in the Nowra Bomaderry Structure Plan – Background Report). The high proportion of regional traffic demonstrates the regional significance of the Nowra Bomaderry town centre. Whilst Nowra Bomaderry is referred to as a regional area there are no other roads State-wide that carry the same amount of traffic as the Shoalhaven River bridges which are not major metropolitan urban arterials or freeways.
- The only viable connection between North Nowra and the Princes Highway is via Illaroo Road. The intersection between the Princes Highway and Illaroo Road is immediately north of the Shoalhaven River bridges. Approximately 17,000 vehicles per day (VPD) use Illaroo Road which is almost three times accepted standards for traffic volumes on a major collector road that has two lanes each way and multiple property access points. Illaroo Road Public School is also located on Illaroo Road.
- Slightly further north, about 250 metres north of the Shoalhaven River bridges, the Highway intersects with Bolong Road, the major access route to Bomaderry. This is a secondary arterial road that links the north east Shoalhaven coastal areas with Bomaderry, extending north to link with Gerroa and Gerringong. Although this arterial road has load restrictions (through the Seven Mile Beach National Park) it carries substantial volumes of regional traffic, often similar to the traffic carried on the Princes Highway.
- Origin-destination surveys show that during the morning peak hour, 70% of traffic on Illaroo Road turns right onto the Princes Highway and crosses the Shoalhaven River Bridge. Of the 30% that turns left out of Illaroo road, approximately half then turns immediately right into Bolong Road. These two significant intersections closely spaced on the northern side of the river create traffic congestion on the Princes Highway which North Nowra traffic is unable to avoid, including the 30% of Illaroo Road traffic which has a destination north of the river. The resulting queues contribute to delays and congestion on the Princes Highway.

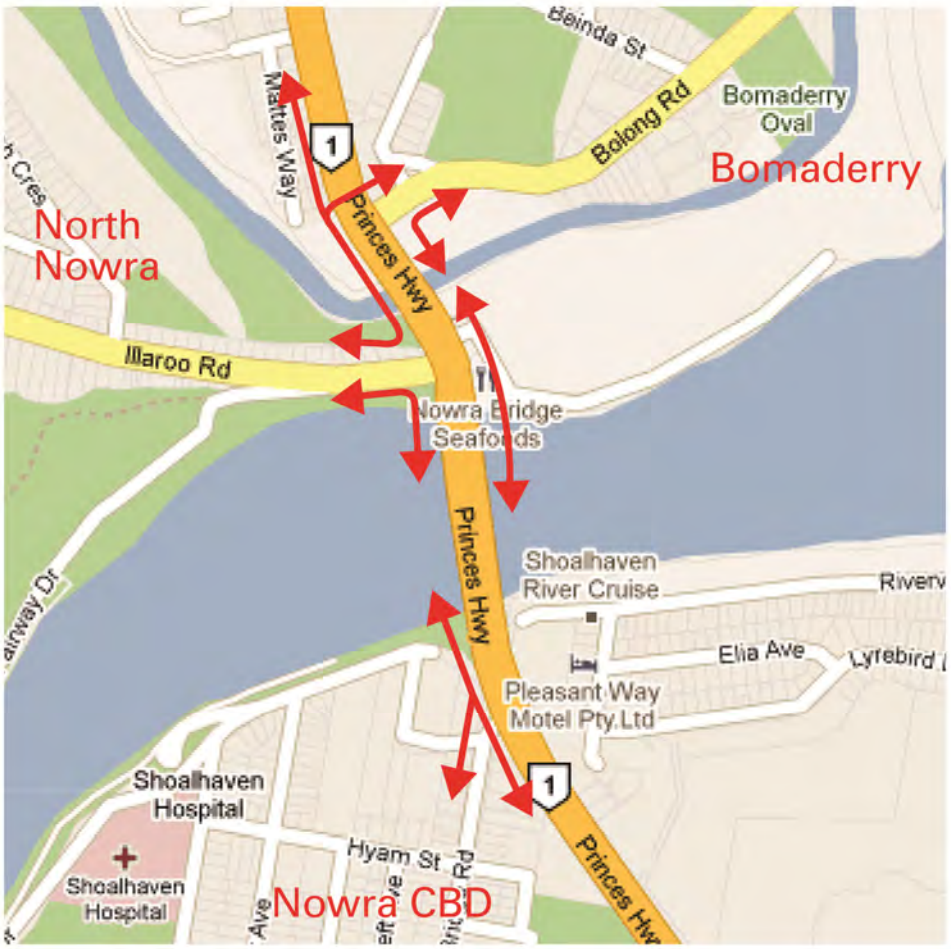
The key traffic movements described above are shown in **Figure 1.4**.

Figure 1-3: Current Urban Structure of Nowra Bomaderry



Source: Map 1.1 of the Nowra Bomaderry Structure Plan 2008 – Strategic Direction, Shoalhaven City Council

Figure 1-4: Principle Traffic Movements Across the Shoalhaven River



1.3 Local and Regional Traffic Funding Responsibilities

The Princes Highway is a State Road – RTA controlled and funded for improvements.

Illaroo and Bolong Roads are, amongst all other roads adjoining the Princes Highway in Nowra Bomaderry, local roads and Council is responsible for managing traffic, safety and amenity on these roads. Taking this into account the North Nowra Link Road project has been developed to satisfy the following project objectives:

- To reduce congestion at the Illaroo Road/Princes Highway intersection.
- To relieve traffic congestion and improve safety and amenity on Illaroo Road, which is subject to frequent congestion.
- To provide infrastructure required to cater for future growth of North Nowra in accordance with the Nowra Bomaderry Structure Plan.

1.4 Traffic Planning History

In 1980, the RTA upgraded the Princes Highway to dual carriageway for the 2.3 kilometres between the Shoalhaven River bridge and Moss Vale Road. A roundabout was constructed at Narang Road/West Birriley Street intersection at a current cost of about $2 million to connect the proposed link road to the Highway. Birrelley Street West was closed to prevent traffic "rat running" through the Bomaderry residential precincts. Since its construction, this roundabout has remained an under-utilised asset for the RTA and the travelling public on the Princes Highway.

In addition to the Narang Road roundabout, roundabout intersections have been installed on the Princes Highway Moss Vale Road/Cambewarra Road intersection, and at Beinda Street/Turley Avenue intersection improving traffic flows on the Princes Highway and local roads.

1.4.1 The 1993 Development Consent

In 1991 Council prepared a Review of Environmental Factors (REF), including a Fauna Impact Statement for the proposed link road. The application was placed on public exhibition in 1992, and in March 1993, Council approved a development consent under Part 4 of the EP&A Act for the construction of an east west road and bridge linking North Nowra to the Princes Highway at Bomaderry.

The approved road followed a cleared services corridor that contained a water pipeline and transmission lines, bridging over Bomaderry Creek and continuing along the alignment of Narang Road connecting to the existing round about on the Princes Highway.

The development consent was legal and not challenged in court, however, the development consent was conditional upon the NSW National Parks & Wildlife Services (NPWS) issuing a licence under Section 120 of the *National Parks & Wildlife Service Act 1974*. The Director-General of the NPWS granted the licence in July 1993.

The NPWS licence was subject to a third party appeal to the Land and Environment Court. The court accepted that there was a need for a road connecting North Nowra with the Princes Highway, however in its consideration as to the merits of granting a licence to take or kill endangered species it found that alternative road options had not been sufficiently investigated. The court found that the granting of a licence to threaten or kill endangered species was not justified on the basis that insufficient investigations had been undertaken to identify whether alternative routes that could provide similar transport benefits may have less impact on endangered species and so determined to uphold the appeal.

Because of the successful legal challenge against the issue of the NPWS Licence the Council's development consent was never acted upon and has since lapsed

1.4.2 Since the 1993 Proposal

Following extensive planning investigations as part of the Nowra Bomaderry Concept Plan which formed the basis of the Nowra Bomaderry Structure Plan, Shoalhaven City Council resolved, in December 2000, to review further options for a preferred route for the North Nowra to Bomaderry Link Road as part of a comprehensive traffic network which meets current congestion concerns and development growth plans for the next 20 to 30 years in the Nowra Bomaderry area.

In December 2002, the NSW Government enacted legislation to form the Bomaderry Creek Regional Park over an area of 82 hectares of what was Crown Land (Bomaderry Creek Regional Park can be seen as green in **Figure 1.2**). Some of the land that would have been affected by the road subject of the 1993 development consent was included within the Regional Park.

The North Nowra Link Road has been an integral component of the strategic planning studies supporting the development of the Nowra Bomaderry Structure Plan which was adopted by Council on 24 October 2006 and endorsed by the NSW Department of Planning on 28 February 2008.

1.5 Overview of Approval Sought

With this application Council is seeking Concept Plan approval of at least 1 route corridor, preferably the selected preferred route corridor (which is Option 1 – the Central Option), being a single road corridor nominally 30 metres wide to accommodate a new North Nowra Link Road.

The proposed road would be developed as a local sub-arterial road with no direct private access. It would be fully funded by Council which has the funding invested in its reserves for the project.

A Concept Plan approval will provide Council with the confidence to progress the design development of the proposed road and to initiate proceedings with the Department of Environment, Climate Change and Water (DECCW) to revoke part of the Bomaderry Creek Regional Park for the proposed road.

If Concept Plan approval is granted by the Minister for Planning then the terms of that approval will set out what further assessment and approvals are required before Council can proceed with any construction activities. Council intend to commence construction works for the proposed road around 2012.

1.6 Approval Process

The *Environmental Planning and Assessment Act 1979* (EP&A Act) governs the approvals process for developments in the State. In August 2005, the Act was amended with Part 3A which deals with the approval of Major Projects. Section 75B(1) of the Act notes that Part 3A applies to development declared under a State Environmental Planning Policy or by order of the Minister for Planning.

On 5 December 2006 the Minister published an order in the NSW Government Gazette No. 186 declaring that the North Nowra Link Road was covered by Part 3A of the Act. A copy of the Gazette notice is reproduced in **Appendix A**.

The Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) has determined that the project constitutes a controlled action, which means it will also require assessment and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. DEWHA has accredited the assessment process established under Part 3A of the EP&A Act, and will therefore assess the project concurrently with the NSW Department of Planning. Notwithstanding the concurrent assessment, the Commonwealth will independently consider and determine the project with consideration of matters of national environmental significance, and may make a different decision to the NSW Minister for Planning or may impose additional conditions on any approval.

On 3 May 2009, in accordance with Section 75F of the EP&A Act, the Director-General of the Department of Planning issued the requirements for the preparation of an Environmental Assessment to accompany a Concept Plan for the project.

A copy of the Director General's Environmental Assessment requirements is also included in **Appendix A**.

This report constitutes the Environmental Assessment Report (EAR) supporting a Concept Plan application for the proposed North Nowra Link Road in accordance with the Minister's order and the DGRs.

1.7 Structure of EA for the Concept Plan

This Environmental Assessment is set out in the following way.

- Part A includes the strategic context and establishes the need for the North Nowra Link Road. It incorporates Section 1 to Section 5 of the EAR.
- Part B provides a site analysis and project description. It incorporates Section 6 and Section 7 of the EAR.
- Part C sets out the statutory requirements and provides the environmental impact assessment. It incorporates Section 8 to Section 19 of the EAR.
- Part D explains why the preferred route was selected and provides an assessment of the project against the heads of consideration of the NSW *Government's Land Revocation Policy* for the Concept Plan and for each of the route options. It incorporates Section 20 to Section 24 of the EAR.

1.8 Limitations of the EA for the Concept Plan

No detailed assessment has been made of temporary construction impacts. These will be dealt with at a subsequent stage of assessment.

There has been a limited amount of design development. Since Council are seeking concept approval a preliminary design of the proposed road has not yet been prepared.

1.9 Project Team

An expert project team has been formed to deliver the project and includes:

Proponent	Shoalhaven City Council
Urban Planning	JBA Planning
Civil Engineering	Jim Alexander Bridge Design
Infrastructure	Shoalhaven City Council
Soil and Water	BeauCon Services Pty Ltd
Water and Flooding Engineers	BMT WBM Pty Ltd
Traffic and Transport	AECOM Australia Pty Ltd
Aboriginal Heritage	Kelleher Nightingale Consulting Pty Ltd
European Heritage	Shoalhaven City Council
Visual Assessment	Shoalhaven City Council
Biodiversity	Ecological Australia
Flora and Fauna	Kevin Mills and Associates
Noise	AECOM Australia Pty Ltd

2.0 Strategic Context

2.1 NSW State Plan

The NSW *State Plan 2010* (the State Plan) is the NSW Government's long term plan to deliver the best possible services to the people of NSW.

The priorities in the State Plan are a result of consultation with more than 3,500 groups and individuals who provided their views and local knowledge. The State Plan reflects the community's vision for the future of NSW in which the top priority is that the transport network is world class—safe, reliable and integrated.

Chapter 1 of the State Plan relates to transport. It identifies that transport underpins our access to jobs, services and facilities, and has a major impact on our quality of life. The NSW Government is integrating the planning of cities and transport systems to improve quality of life, boost the economy and help the State to face the challenges of the future.

Relevant State Plan priorities include to:

- Improve the road network – with a target to "improve the efficiency of the road network during peak times as measured by travel speeds and volumes on Sydney's road corridors."
- Improve road safety – with a target to "reduce fatalities to 4.9 per 100,000 population by 2016".

Other targets and measures that have been identified as being of potential relevance to the project:

- State plan priority to "Grow cities and centres as functional and attractive places to live, work and visit".
- State Plan priority to "Improve housing affordability", with a target to "provide at least 300,000 new dwellings in regional areas over the next 25 years, with an increased rate of infill development."
- State plan priority to: Protect our native vegetation, biodiversity, land, rivers and coastal waterways", with a target to "meet our State–wide targets for natural resource management to improve biodiversity and native vegetation, sensitive riverine and coastal ecosystems, soil condition and socio–economic wellbeing." The relevant State-wide natural resource management target is that there is an increase in the recovery of threatened species, populations and ecological communities.

2.2 South Coast Regional Strategy

The *South Coast Regional Strategy 2006* (the South Coast Regional Strategy) sets out the NSW Government position on the future of the South Coast. It is the "pre-eminent planning document to the South Coast Region and has been prepared to complement and inform other State Planning instruments". One of the principle aims of the Strategy is to manage the environmental impact of settlement by focussing new urban development in existing identified growth areas such as Nowra-Bomaderry.

Under the Strategy, the South Coast Region is forecast to grow by 60,000 additional people by 2031. The City of Shoalhaven contribution is to accommodate an additional 26,300 dwellings, 14,400 new jobs and 34,000 people. 15,800 of this additional growth is projected to be accommodated within existing vacant urban land and investigation areas, with the remaining supply gap to be accommodated through medium-density development within the town-centres.

Most of this growth will be in Nowra Bomaderry which has been identified as a Major Regional Centre under the Strategy. As such, its role as determined by the NSW Government is to be the major residential, employment and administrative area for the northern part of the Region. It is a "focal point for subregional road, transport and employment opportunities".

The Strategy identifies that the major road network, including the Princes Highway, is very important for connecting communities, supporting economic development and linking to neighbouring regions. The Strategy further states that there are transport and access limitations in the South Coast Region due to the dispersed settlement pattern and that more work is needed to understand the long term implications of regional growth and settlement on the regional road network.

The Biodiversity Outcomes of the South Coast Regional Strategy include:

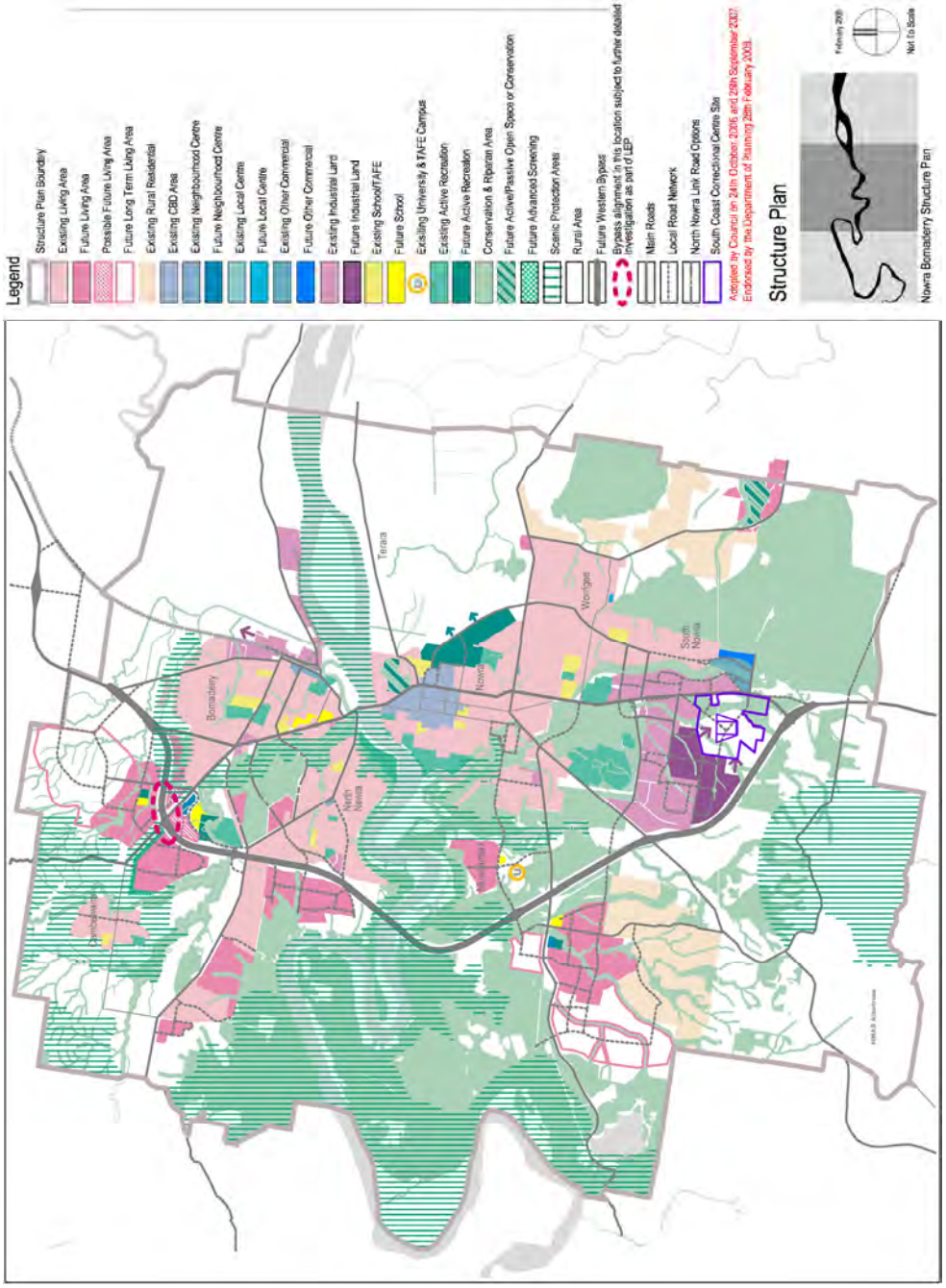
- To maintain or enhance the quality and distribution of the Region's biodiversity over time.
- To direct urban development away from areas important for conservation.
- To protect, enhance and reinstate the values and functions of riparian corridors.

2.3 Nowra Bomaderry Structure Plan

The Nowra Bomaderry Structure Plan (NBSP) provides strategic direction and guidance, including identifying land that will be further investigated in detail for possible rezoning. The NBSP was adopted by Council in 2006 and endorsed by the NSW Department of Planning in 2008.

Figure 2.1 is the adopted demographical projection and endorsed Structure Plan for Nowra Bomaderry. The endorsed Structure Plan incorporates the North Nowra Link Road options, shown as dashed lines on the map.

Figure 2-1: North Bomaderry Structure Plan



Source: Map 1.2 of the Nowra Bomaderry Structure Plan 2008 – Strategic Direction, Shoalhaven City Council

2.3.1 North Nowra – Existing Population Profile

The North Nowra precinct is identified in the NBSP Background Report as including 980 hectares, primarily residential in nature although containing a small commercial centre and a small industrial area. The North Nowra precinct accounts for 21% of the population covered by the Structure Plan, 20% of its dwelling stock at and a gross density of 6.57 persons per hectare and 2.60 dwellings per hectare.

In comparison the population, area, dwelling stock, and density of persons and dwellings per hectare of Nowra City Centre and Bomaderry, being the other 2 main population centres are provided in **Table 2.1** below.

Table 2-1: Existing Characteristics of Residential Development in North Nowra, Bomaderry and Nowra CBD.

Characteristic	Nowra CBD	Bomaderry	North Nowra
Population	11,887	6,572	5,962
Area	1,478	792	980
Existing Dwellings	4,912	2,808	2,357
Population Density (per hectare)	8.07	8.30	6.57
Dwelling Density (per hectare)	3.32	3.55	2.60

Source: Table 4.1 of the Nowra Bomaderry Structure Plan 2008 – Background Report, Shoalhaven City Council

Note: Data in the Table is obtained from the Nowra Bomaderry Structure Plan - Background Report 2008, which was superseded by the NBSP – Strategic Direction 2008 and so the numbers may not match exactly the numbers below which are taken from the updated Strategy Direction. The numbers are, however, consistent.

2.3.2 Projected Population Growth in Nowra Bomaderry

The Structure Plan is based upon the growth objectives laid down in the South Coast Regional Strategy. The population growth anticipated by the South Coast Regional Strategy for Nowra Bomaderry is growth from 32,000 in 2006 to almost 54,000 people by 2036.

The NBSP identifies that population growth will be accommodated by a mix of both "greenfield" sites and infill development.

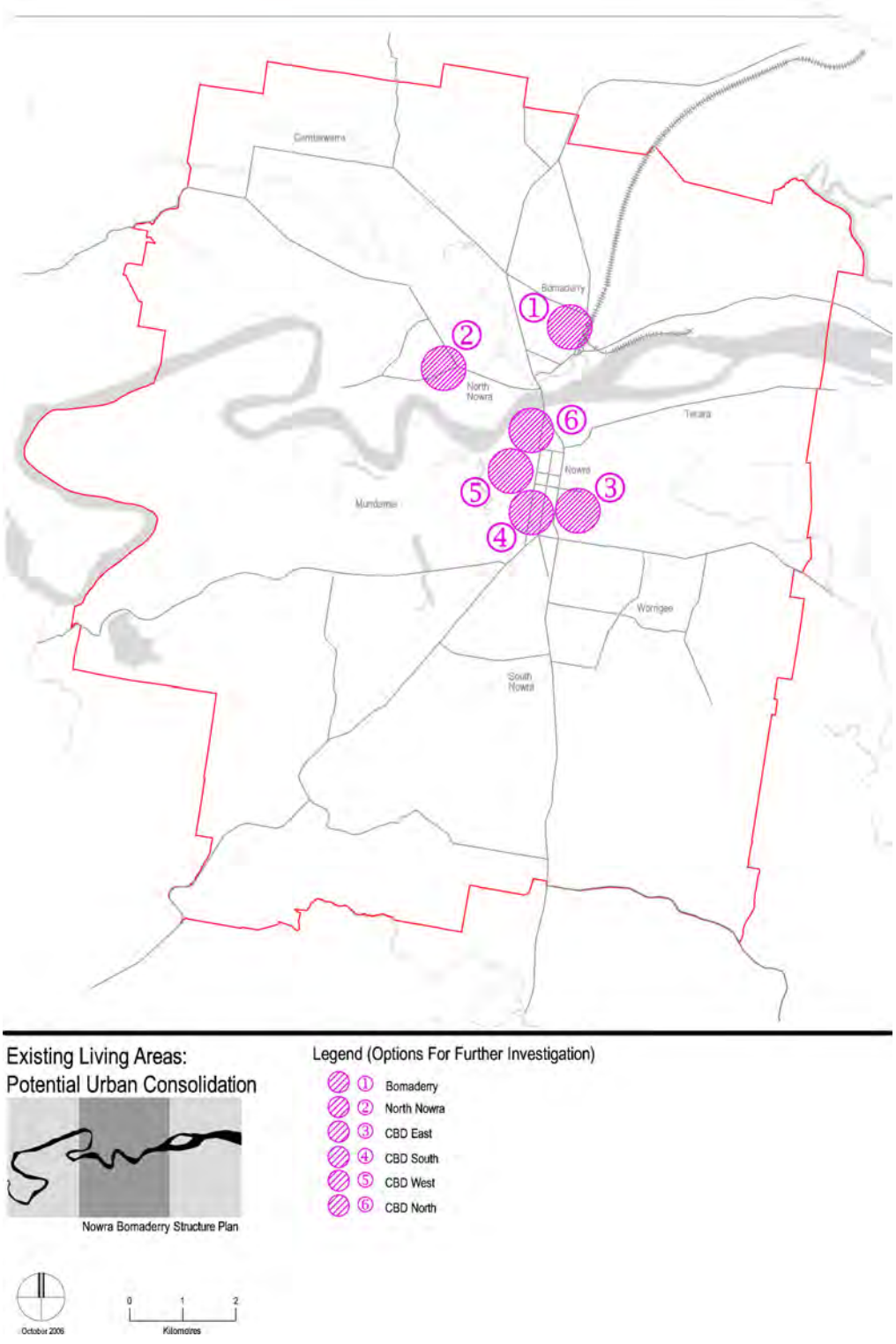
2.3.3 Growth in Existing Living Areas – North Nowra

Figure 2.2 shows the location of the existing living areas with the identified potential for growth in Nowra Bomaderry.

The NBSP identifies North Nowra as an existing living area which will be further investigated by Council for increasing housing density. The reasons why North Nowra is identified for this purpose include:

- Proximity to Nowra City Centre provides access to a wide range of retail and commercial services.
- An existing neighbourhood shopping centre is located on the corner of Illaroo Road and McMahons Road.
- Proximity to open space and recreation facilities including the north bank of the Shoalhaven River.
- Potential for housing renewal in keeping with the existing character of the neighbourhood.

Figure 2-2: Existing Living Areas with Potential for Growth in Nowra-Bomaderry



Source: Map 2.1 of the Nowra Bomaderry Structure Plan 2008 – Strategic Direction, Shoalhaven City Council

Established native vegetation provides a valuable contribution to the neighbourhood's identity, with well-planted streets and views to bushland surrounds.

The NBSP identifies the following key constraints to the increasing of housing density at North Nowra:

- Illaroo Road provides the only viable vehicle access between North Nowra and the Princes Highway. There are already accessibility and safety concerns with the current volumes of traffic along Illaroo road and the intersection with the Princes Highway is already congested in peak periods.
- A curved street network with many cul-de-sacs provide few through routes.
- Native vegetation and bushfire risk issues on the edges of North Nowra.

The desired future for North Nowra, as foreseen in the NBSP, is for consolidation of residential housing, as low scale medium density development along main roads and close to the existing neighbourhood shopping centre (i.e. on Illaroo Road and McMahons Road near their intersection – which is shown as Area 2 in **Figure 2.2**).

The NBSP identifies the number of dwellings that could be provided based on the current zoning capacity and contrasts it with the number of dwellings that could be provided if urban consolidation and revitalisation was encouraged through zoning and incentives for developers. For North Nowra, it identified the following:

- An additional 222 dwellings could be provided for in North Nowra on top of the existing 2,452 dwellings, based on the current residential zoned land capacity.
- An additional 1,805 dwellings could be provided for in North Nowra if the housing density was increased in strategic locations through zoning and incentives for consolidation and revitalisation. This is particularly envisaged in the area surrounding the existing North Nowra neighbourhood centre on the corner of Illaroo Road and McMahons Road.

2.3.4 New Living Areas

Figure 2.3 shows the location of the New Living Areas in Nowra Bomaderry.

The NBSP identifies a New Living Area for future residential development to the west of the existing residential development at North Nowra. The 90 hectare area is identified as Crams Road, with a projected population of 2,700, and 1,080 dwellings at 12 dwellings per hectare. Other new living areas are planned, as shown in **Figure 2.3**.

The Structure Plan also identifies 2 possible future living areas on existing Crown Land and Council-owned land. One is located to the east of Illaroo Road opposite the intersection with Pitt Street (on Crown Land) and the other on a triangular piece of land to the south of West Cambewarra Road (on Council-owned land).

2.3.5 Regional Transport Strategy

To allow for the projected growth to occur successfully in North Nowra, adequate infrastructure will be required, including transport infrastructure.

The NBSP identifies that the Princes Highway is the weak link of the Nowra Bomaderry road network because of its many intersections, with classified and designated regional roads, collector roads, and local roads, many of which intersect at single locations along the Highway with minimal or inadequate opportunities for traffic to seek alternative routes.

Being the single north-south route through Shoalhaven City, the NBSP identifies that the Princes Highway has a multiple function as an important link in the State road network, as a collector and distributor road, and as a local access road. According to the NBSP it is therefore not surprising that the sustained increases in traffic on the Princes Highway has resulted in safety and capacity issues along its entire length within Shoalhaven City, and that without significant capital investment the Princes Highway and its key intersections will continue to suffer from major capacity deficiencies and resultant safety issues as a consequence of growth envisaged under the South Coast Regional Strategy and the Nowra Bomaderry Structure Plan.

Origin and destination surveys carried out in 1994 and in 2003 and reported in the NBSP indicate the following:

- 5% of traffic across the Shoalhaven River bridges is direct through traffic, i.e. traffic neither originating nor stopping in the Nowra Bomaderry area.
- 5% of traffic across the Shoalhaven River bridges is in-direct through traffic, i.e. traffic driving through Nowra Bomaderry which stops for less than 30 minutes for amenities, fuel etc.
- 50% of traffic across the Shoalhaven River bridges is local traffic generated within the Nowra Bomaderry area and not leaving Nowra Bomaderry.
- 40% of traffic across the Shoalhaven River bridges is regional traffic generated outside of Nowra Bomaderry, that enters and exits Nowra Bomaderry predominantly returning to the same location as origin.

In the long term, a Future Western Bypass of Nowra has been planned for in the NBSP, as shown in **Figure 2.1**, and also shown in the proposed future road network under the Structure Plan provided in **Figure 2.4**. However, the NBSP identifies that the Future Western Bypass will not solve the issue at the Shoalhaven River bridge crossings because only a small percentage of trips across the bridge are through traffic. The traffic modelling undertaken for the Nowra Bomaderry Structure Plan identifies a minimum number of access points along the Western Bypass to achieve an optimum shift in traffic from the Princes Highway to the Western Bypass. The maximum shift in traffic to the Bypass however still only represented some 15% of traffic. Any reduction in the number of access points will result in a lower shift of traffic to the Western Bypass which could impact the viability and timing of the project, and concentrate higher volumes of traffic on the existing Princes Highway and local roads, an issue which has been discussed with the RTA.

The NBSP asserts that while the Future Western Bypass could be expected to perform a much needed major collector road role, additional Shoalhaven River crossing capacity at or to the east of the existing bridges would also be required to account for local and regional traffic. The NBSP Background Report identifies that by 2036 if sustained traffic growth continues with current travel demand patterns it is likely that 2 additional crossings of the Shoalhaven River would be required to address high levels of traffic congestion and unreasonable impacts on local roads, in addition to the Future Western Bypass.

In light of the identified constraints of the Future Western Bypass, the NBSP identifies a set of infrastructure improvements to the local traffic network in the short to medium term:

- A North Nowra Link Road to provide an alternative route between Illaroo Road and the Princes Highway, taking pressure off the Illaroo Road/Princes Highway intersection.

- Intersection improvements at the three key intersections with the Princes Highway north and south of the existing bridges being the Princes Highway intersections with Bolong Road and Illaroo Road to the north of the bridges and Bridge Road to the south of the bridges.
- A Nowra CBD (East) Road Network Strategy which includes identified upgrades to the Princes Highway through Nowra CBD and includes an East Nowra sub Arterial Road which is a new road connecting Greenwell Point Road to the Princes Highway providing an alternative connection to the Highway from East Nowra, Worrigee and coastal village areas.
- A South Nowra Road Strategy to address the gradual deterioration in the levels of service and safety on the Princes Highway through south Nowra.

Council is also planning to construct a new link between Illaroo Road and Moss Vale Road to provide North Nowra with access to the new living areas in the vicinity of Moss Vale Road – including a new neighbourhood centre and high school, and to link the new living areas with the schools, shops and services in North Nowra. The locations of the new living areas in the vicinity of Moss Vale Road are shown in the Structure Plan in **Figure 2.1**.

2.3.6 Safety on the Existing Road Network

Along with the increasingly high traffic volumes carried by Princes Highway, numerous intersections within the Nowra-Bomaderry local road network now rank as major accident blackspots. Between 1998 and 2003, there was 1056 reported road crashes within Nowra-Bomaderry, resulting in a total of 669 casualties and 12 fatalities. Of the 495 crashes within Nowra-Bomaderry that resulted in the 669 casualties, 179 of these occurred on RTA roads (164 on the Princes Highway and 15 on Moss Vale Road).

The location with the highest number of crashes in Nowra-Bomaderry is the intersection of Illaroo Road with the Princess Highway with 32 crashes resulting in 16 casualties. The next 5 highest major crash locations are located on the Princes Highway. Other major crash locations that are relevant to the project are:

- Illaroo Road/McMahons Road – 9th with 9 crashes resulting in 6 casualties.
- Illaroo Road/Crescent Street – 18th with 5 crashes resulting in 5 casualties.
- Illaroo Road and Phillip Street – 19th with 5 crashes resulting in 4 casualties.

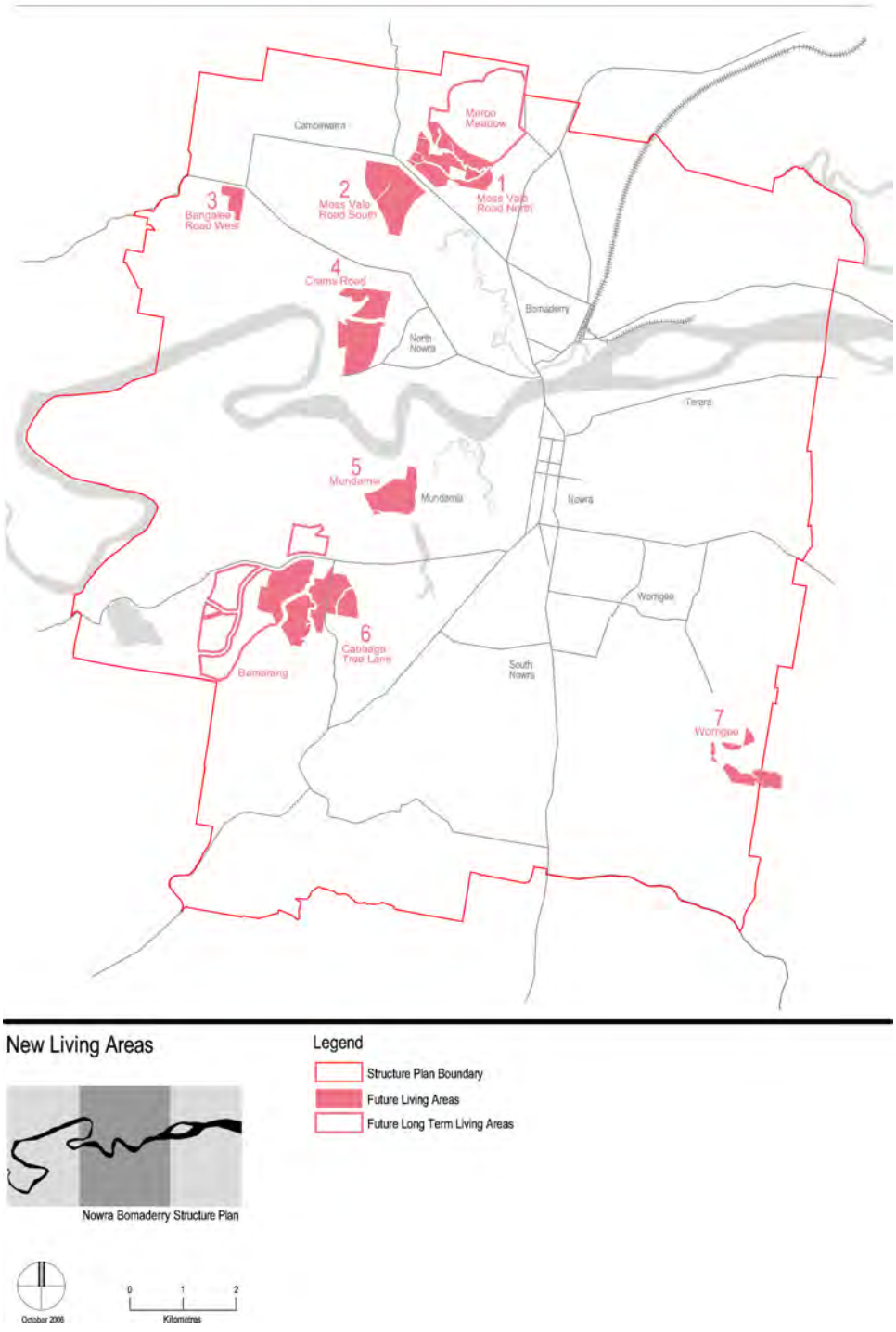
The busiest time of day for accidents is during business hours between 10am to 4pm. This period of the day accounts for 38% of traffic accidents within the study area. The PM peak period from 4pm until 7pm is the time of day that 24% of accidents occurred. A further 25% of all accidents took place in the night period between 7pm and 7am. Only 15% of accidents occurred in the AM peak period from 7am until 10am. Thus, approximately 62% of recorded accidents took place between 10am and 7pm.

The accident data indicate that the busiest hour for traffic accidents on Illaroo Road occurs in the peak hour between 4-5 PM, and the second busiest hour throughout the day, between 3-4 PM.

Safety levels can be expected to deteriorate along Illaroo Road for all road users as traffic levels and congestion increase, which is of on-going and significant concern to Council and the local community.

The NBSP has also identified a need for general safety improvements along Princes Highway.

Figure 2-3: Identified New Living Areas in Nowra-Bomaderry



Source: Map 2.2 of the Nowra Bomaderry Structure Plan 2008 – Strategic Direction, Shoalhaven City Council

2.3.7 Future Road Network

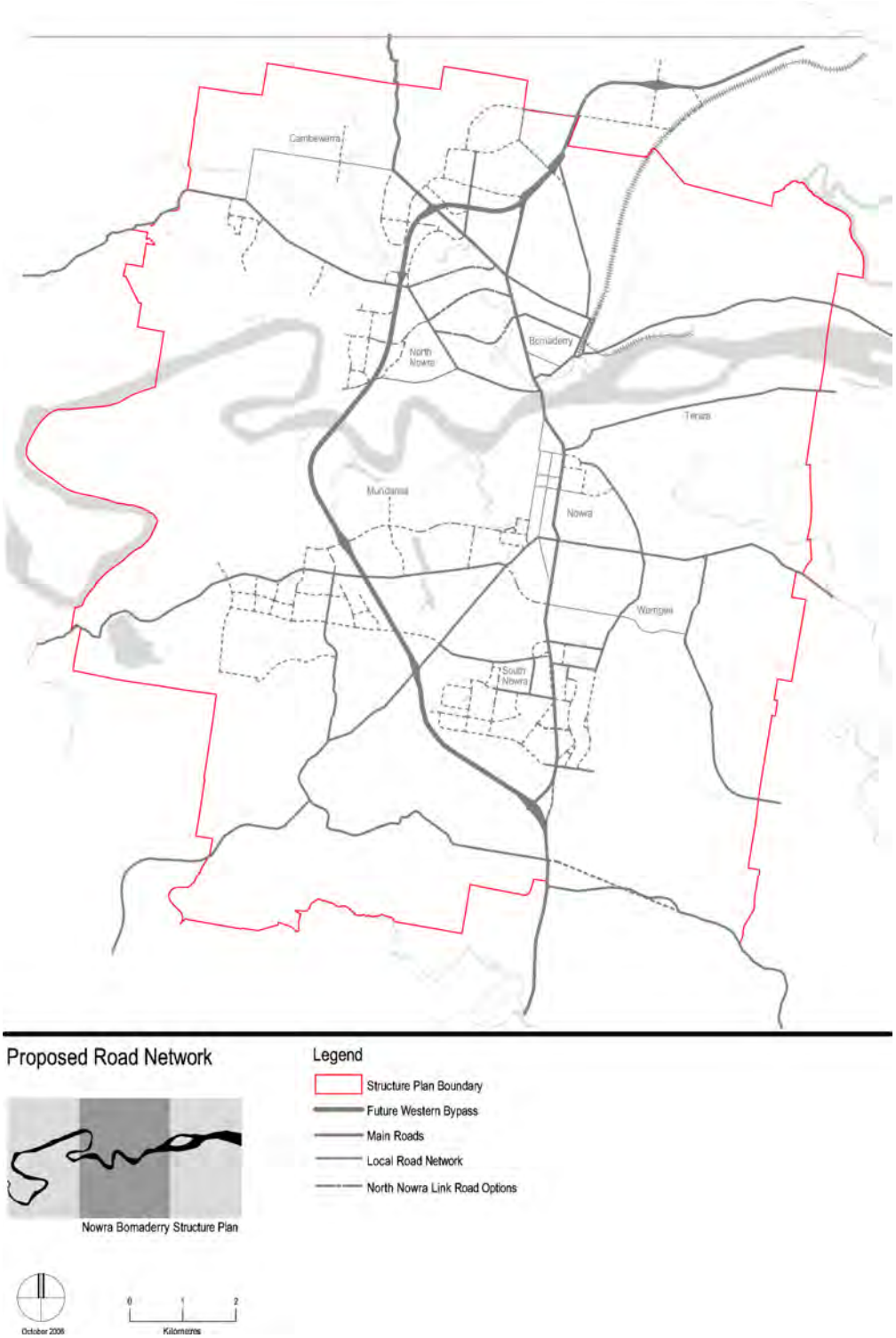
The NBSP identifies that the link road is an integral part of the Structure Plan, because it would enhance the capacity of the existing road network and allow it to accommodate the needs of current and future residents.

The proposed future road network in the NBSP is shown in **Figure 2.4**. It is highlighted that the New Living Area at Crams Road is proposed to link primarily through Pitt Street and McMahons Road to Illaroo Road, providing significant additional traffic growth in this southern section of North Nowra.

The NBSP identifies that the North Nowra Link road will provide a much needed alternative route from North Nowra to the Princes Highway, alleviating pressure on the Princes Highway in the critical link across the Shoalhaven River between Bolong Road (to the north) and Bridge Road (to the south). It will also give an opportunity for approximately 30% of traffic travelling to/from North Nowra to avoid the Princes Highway / Illaroo Road intersection, resulting in marked improvement to network operations and local accessibility.

The NBSP identified a link road as being justified in the short term, regardless of new developments in North Nowra/Bomaderry, and has the potential to defer a new crossing of the Shoalhaven River. Even if no additional growth were to occur in North Nowra, queuing would still extend considerably along Illaroo Road as phasing at the Princes Highway / Illaroo Road intersection is modified over time by the RTA to provide more efficiency for the through flows along the highway. Therefore, should that the new link road not be provided, the feasibility of directing new growth to North Nowra could be seriously compromised and lead to further deterioration of safety conditions and amenity along Illaroo road for existing residents.

Figure 2-4: The Proposed Future Transport Network in Nowra-Bomaderry



Source: Map 6.1 of the Nowra Bomaderry Structure Plan 2008 – Strategic Direction, Shoalhaven City Council

3.0 Constraints in the Local Traffic Network

The NNLR project aims to address the constraints in the existing traffic network and provide an important element of the necessary capacity improvement to accommodate future growth as envisaged under the endorsed NBSP. This Section describes the constraints in the existing traffic network with reference to traffic modelling carried out by Shoalhaven City Council and Maunsell | AECOM (AECOM). AECOM's traffic modelling is described in detail in **Appendix E**.

3.1 Traffic Modelling of the Road Network

Council developed the Nowra Bomaderrry TRACKS transportation model in 1995. TRACKS is used by Council to model the impacts of land use and transport changes and has been an integral component of the preparation of a strategic transport direction within the NBSP.

In particular, the preparation of future population and employment data out to 2036 (as per the South Coast Regional Strategy) has been put into the TRACKS model to carefully analyse the build up of traffic relating to background traffic growth and the resultant impacts of new development and to identify network deficiencies and possible solutions.

This internal TRACKS investigation provided the RTA and Council with significant foundation of background data which assisted in understanding the potential responsiveness of existing traffic patterns to change.

It is expressly noted that TRACKS is used by Council to support its strategic planning functions and whilst it provided fundamentals that supported Council's internal processes it is not intended to provide technical support to the Environmental Assessment. Notwithstanding this, a review of Council's TRACKS investigations was undertaken by Gabites Porter and is provided as part of **Appendix E** (the Gabites Porter report is Appendix F of the AECOM "North Nowra to Bomaderry Link Road Options Study" report).

AECOM was commissioned in 2006 and 2007 to undertake comprehensive traffic modelling and analysis of the local road network, with joint funding and technical overview by the RTA (Southern Region). Council commissioned AECOM to provide a traffic analysis to support the preparation of the Environmental Assessment, and it is provided in **Appendix E**.

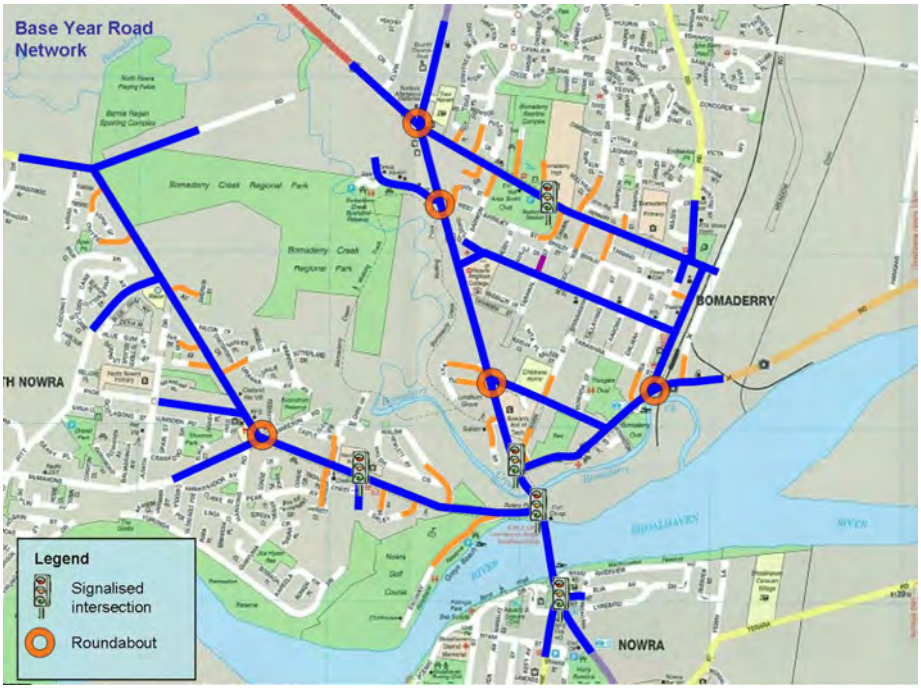
The results of the TRACKS analysis were beneficial as a precursor to the AECOM traffic modelling and were used internally by Council to confirm the robustness of the AECOM analysis, and to verify AECOM's model. Whilst TRACKS provides a different field of numeric results, being based on a 24 hour period of assessment compared to the AECOM analysis, which examined constrained morning and afternoon peak periods in detail, AECOM's results were considered to be consistent with the TRACKS analysis.

The AECOM traffic study uses a Paramics micro-simulation traffic model to characterise the constraints on the existing traffic network, and this is described further in Section 3.2 below.

3.2 Paramics Model Parameters

A detailed Paramics micro-simulation model was developed by AECOM for the North Nowra to Bomaderry area including Illaroo Road between West Cambewarra and Princes Highway, Princes Highway between Cambewarra Road and Bridge Road, Bolong Road between Princes Highway and Railway Street, Meroo Street and Meroo Road, Beinda Street, Bunberra Street and Cambewarra Road. The extent of the local traffic model is shown in **Figure 3.1**.

Figure 3-1: Extent of AECOM's Traffic Model



Source: AECOM, 2010

3.3 Future Growth in North Nowra

The Nowra Bomaderry area is projected to increase in population from 30,200 to 53,700 in 2036, a 78% expansion.

North Nowra is identified as one of the key growth precincts in the Nowra Bomaderry Structure Plan. The number of dwellings in the North Nowra Existing Living Area is projected to increase by 2,227 dwellings by 2036 of which 1,805 is expected to occur through urban consolidation and revitalisation around the Illaroo Road and McMahons Road intersection, as shown generally as Area 2 in **Figure 2.2**.

Traffic growth assumptions have been developed by AECOM from this level of projected population growth.

3.4 Traffic Growth Scenarios

An AM and PM peak base model was developed and calibrated to reflect traffic conditions in 2005, based on extensive traffic surveys to ensure the model was accurately validated to simulate existing traffic conditions. The model parameters were then modified to consider traffic flows in 2016 under two different demand scenarios, being:

- No local development growth scenario: Traffic demands based on existing (base year 2005) demands plus a nominal 2% growth per annum applied to Princes Highway and Bolong Road (through flows only) determined by approximating from RTA growth data and which is considered a reasonable and sustainable long term growth rate for purposes of analysis. The 2016 AM and PM demand matrices based on 2% growth per annum along Princes Highway and Bolong Road were developed by increasing the through trips along Princes Highway and Bolong Road by approximately 450 and 500 additional trips on the road network during the AM and PM peak periods respectively. This is a low growth scenario which assesses the impact of increasing Princes Highway traffic volumes on the local road network, particularly Illaroo Road even if there were no additional growth in North Nowra or Bomaderry.
- Local development growth in accordance with NBSP: Traffic demands determined from growth in line with the NBSP resulted in approximately 2000 and 3000 additional trips on the road network during the AM and PM peak periods respectively in addition to growth in through traffic on all main roads (Princes Highway, Bolong Road and Moss Vale Road). Due to such large growth projected throughout Nowra-Bomaderry, to ensure that the modelling remains sufficiently robust growth on the Princes Highway & Bolong Road were limited to 2% p.a. This scenario assumes additional local traffic generation through-out Nowra-Bomaderry, including the additional traffic growth projected in the NBSP for North Nowra

In addition to the base case these two scenarios represent the year 2016 with a "low growth" and a "high growth" scenario respectively, as a basis for testing and comparing the link road options. It was intended at the commencement of the study to model scenarios up to year 2036 however it was found that because of constraints on the Princes Highway in the vicinity of the existing Shoalhaven River bridges that it would not be possible to extend the models beyond 2016 as the models were already operating at practical capacity.

What this means is that a lower growth scenario than what is actually predicted was used, and the model limited to 2016 to ensure that the model remained operational and continued to provide results that were able to differentiate the route options.

Whilst the forward projection year of 2016 is nearing, it is considered unnecessary to upgrade the 2005 year analysis on the basis that while the working model may incrementally change to reflect a worsening position, the fundamental outcome will not change. Any new model will be subject to the same limitations described above (i.e. limits on the amount of traffic on the network) and is therefore not going to be able to provide any results that are substantially more accurate, meaningful or forward looking. The RTA is supportive of this approach.

3.5 Model Outputs

The Paramics model was run to generate the following outputs to assist in characterising the general performance of the entire network as well as identifying specific locations within the network that are affected by significant traffic congestion.

- General network performance measures including Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) and average speed for vehicles across the entire network.
- Turn flows at the thirteen key intersections, including the Princes Highway/Illaroo Road signalised intersection.
- Traffic flows at critical mid-block locations.
- Travel times along Princes Highway, Illaroo Road and Bolong Road being the three main local transport routes.
- Level of Service and average vehicle delay at the thirteen key intersections, including the Princes Highway/Illaroo Road signalised intersection.

One of the key outputs from the model is the projected increase in traffic that will travel along Illaroo Road. The projected increase in traffic along Illaroo Road in accordance with the above growth scenarios is shown below in **Table 3.1**. The table shows the mid-block Paramics modelled traffic flows. The number of vehicles travelling along Illaroo Road clearly increases the further south along the road that it is modelled. This reflects the southern bias of traffic generation to and from North Nowra, with more than two-thirds of traffic being generated at or south of Pitt Street. Other differences in traffic levels are associated with the ability for traffic on Illaroo Road to be absorbed on to the Princes Highway within the respective peak hours. The traffic signal phasing at the Princes Highway is optimised with each scenario to provide maximum capacity responsive to changes in traffic levels and because of the constrained (congested) peak periods in some cases not all peak hour traffic is able to access the Princes Highway within the peak hour.

The small differences in the amount of traffic growth along Illaroo Road between 2005 and 2016 Low Growth scenario reflect that the Low Growth model scenario does not provide for any increase in population in North Nowra. Rather it only accounts for additional traffic growth on the Princes Highway and Bolong Road in accordance with RTA historical growth rates of 2%.

Table 3-1: Mid-block Traffic Flows

Between Intersections AM Peak Modelling	**2005 Base Flow (modelled)**	**2016 Low Growth**	**2016 High Growth**
West Cambewarra Road – Pitt Street	396	427	460
Pitt Street – Page Avenue	478	527	599
Page Avenue – McMahons Road	685	758	846
McMahons Road – Crest Avenue	1099	1177	1410
Crest Avenue – Princes Highway	1647	1598	1779
Between Intersections PM Peak Modelling	**2005 Base Flow (modelled)**	**2016 Low Growth**	**2016 High Growth**
West Cambewarra Road – Pitt Street	406	427	475
Pitt Street – Page Avenue	521	547	656
Page Avenue – McMahons Road	823	851	1216
McMahons Road – Crest Avenue	1323	1327	1675
Crest Avenue – Princes Highway	1612	1636	1894

Source: AECOM, 2010

3.6 Key Constraints Modelled on the Road Network

The issues characterised from the AECOM Paramics traffic modelling with regard to traffic in the North Nowra to Bomaderry study area in 2016 are:

- Congestion at the Illaroo Road/Princes Highway Intersection.
- Congestion on Illaroo Road.
- Congestion on the Princes Highway, including the Shoalhaven River Bridges.

These issues were identified based on the output parameters described above, as well as from the observation of the visual representation of traffic conditions as they change through the modelling period, which Paramics also provides. Each of these three issues is discussed further below.

3.6.1 Congestion at the Illaroo Road / Princes Highway Intersection

The proximity of the Princes Highway / Illaroo Road intersection with the Princes Highway / Bolong Road and the Princes Highway / Bridge Road signalised intersections (providing limited storage space), causes significant congestion and acts as a 'throttle' to traffic travelling along Princes Highway. Extensive queuing also occurs for traffic turning right from Illaroo Road.

Figure 3.2 shows the layout of the Illaroo Road Princes Highway intersection. The intersection is signalised and includes:

- Three through traffic lanes on the Princes Highway, which also carries traffic feeding in to and out of Bolong Road 200 m north of the Illaroo Road intersection.
- Right turn from Highway into the Illaroo Road via a dedicated right turn lane.
- Illarroo road is two lanes in each direction. There are two right turn lanes from Illaroo Road onto the Princes Highway, the left hand lane shared with traffic turning left onto the Highway. The southern most lane is a free flowing left turn slip lane from the Princes Highway, impacted only by marked foot crossing at the junction.

Weekday morning peak hour traffic between the Shoalhaven River Bridge and Bolong Road (taking in the Illaroo Road/Princes Highway intersection) becomes heavily congested.

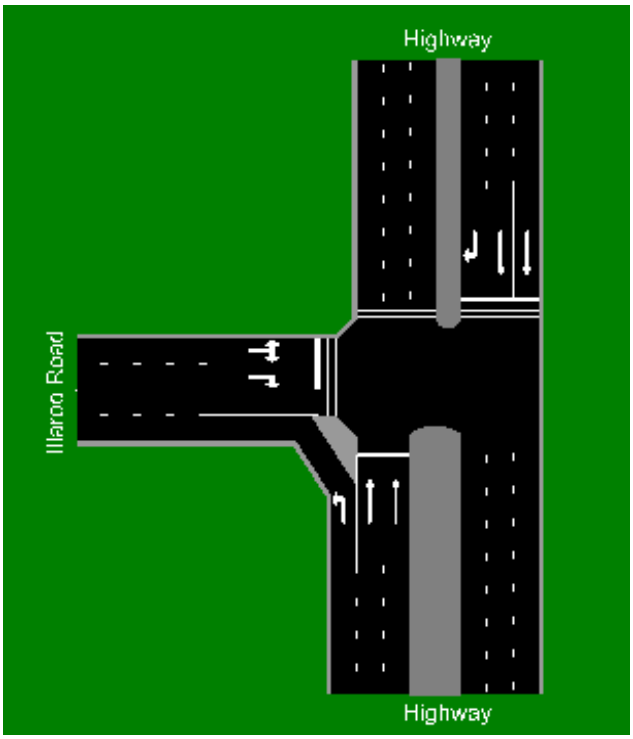
During the morning peak, as modelled by AECOM for the 2005 base year, the Illaroo Road/Princes Highway intersection has a performance Level of Service of C, and a Level of Service B during the PM peak period (the RTA recommended Level of Service of C or better).

With the "high" growth scenario (based on growth in accordance with the NBSP), by 2016, modelling indicates that the Level of Service would deteriorate to F during the morning and afternoon peaks, which is the lowest Level of Service possible. However, even based on the lower growth scenario modelling indicates that the Level of Service would still deteriorate to F during the AM peak and Level of Service E during the PM peak.

Recent observations made in 2009 / 2010 confirm the traffic situation has deteriorated since the 2005 base model. Bolong Road southbound traffic now frequently requires four signal phases for entering the Princes Highway.

The Princes Highway southbound dedicated right turn lane into Illaroo Road frequently operates in the morning peak at full capacity and beyond preventing through traffic in the centre lane. This is evidence of the strong correlation between Bomaderry and North Nowra which impacts the efficiency of the Princes Highway immediately north of the river. This would normally indicate that more green time is required for the phase providing for right turn movements into Illaroo Road from the Princes Highway, however this is the minor phase and any increases in green time for the minor phase impacts significantly on the efficiency of the major phases being Princes Highway through traffic and Illaroo Road phases. If overall cycle time is increased this would lead to more extensive queuing on all legs highlighting the need for an alternative solution to alleviate the Illaroo Road general morning peak congestion.

Figure 3-2: Existing Princes Highway / Illaroo Road Intersection Arrangement



Source: AECOM, 2010

3.6.2 Congestion on Illaroo Road

Illaroo Road is the only access from North Nowra to the Princess Highway, Bomaderry and Nowra town centre. Illaroo Road is a local access road with numerous local road connections and private accesses.

Queuing back from the Princes Highway on Illaroo Road regularly extends significant distances from the intersection, anecdotally extending beyond the McMahons Road intersection some 1.65 km from the intersection along Illaroo Road. This causes large delays for vehicles exiting the minor residential streets at priority intersections and it could be expected that community perception would interpret traffic conditions based on this level of traffic to be untenable for residential driveway access and basic pedestrian safety. Anecdotally, in school holidays, traffic through the Illaroo Road/Princes Highway intersection is generally acceptable.

Extensive queuing is observed to continue on Illaroo Road when modelled under the "low" growth scenario. Under the "high" growth scenario (i.e. growth in accordance with the NBSP) queuing on Illaroo Road was observed to worsen.

Particularly during the morning and evening peak hours, the poor operation of the Illaroo Road/Princes Highway intersection causes traffic to back up for over 2 kms along Illaroo Road, sometimes beyond the Pitt Street intersection, some 2.7 km from the Princes Highway intersection.

Of all accidents along Illaroo Road 60% have occurred where no traffic controls exist, a reflection of substantial delays at minor intersections. Residents and users of Illaroo Road have submitted extensive complaints over a long period about the delays, safety concerns and loss of residential amenity from traffic in their community. With further population growth in the area, these problems will be exacerbated.

The RTA is responsible for managing the flow of traffic on the Princes Highway. As congestion on the Highway increases, due to intersection constraints, then the RTA will be obliged to provide additional green time at the signals, which will further impact on the amount of queuing and congestion on Illaroo Road.

3.6.3 Congestion on the Princes Highway

As a result of the congestion at the Princes Highway / Illaroo Road intersection and Shoalhaven River Bridge crossing, whilst there is significant seasonal fluctuation throughout the year, typically queuing is modelled to occur on Princes Highway extending beyond Beinda Street (1 km queue) and in some instances up to the West Bunberra Street or Narang Road intersections. Anecdotal evidence indicates that queuing extends approximately 2.25 km up to the Moss Vale Road / Cambewarra Road intersection. To avoid the queues on Princes Highway some vehicles are observed to rat-run via Meroo Street, Beinda Street and Bolong Road.

Shoalhaven Bridge Crossing is congested with traffic being throttled in a southbound direction along Princes Highway. In particular during the AM peak where the number of right turn movements from Princes Highway onto Bridge Road has been forecast to increase by approximately 65% in 2016, which is consistent with current anecdotal evidence. The modelling showed that the level of queuing currently extends to obstruct the adjacent through lane hindering through vehicle movements occasionally during AM and PM peak hours in average weekday flow conditions.

The 2009 / 2010 conditions observed confirm the modelling to the extent that the AM peak demonstrates frequent blocking of the southbound right turn lane into Bridge Road, which occurs for approximately half the AM peak hour. This situation becomes considerably worse during higher seasonal flows leading to substantial queuing along the Princes Highway and as a consequence at all minor roads intersecting with the Princes Highway.

The modelling indicated the queuing condition worsens in 2016 such that the maximum queuing extends to north of the Shoalhaven River for most of the peak hour due to a significant increase in southbound traffic flow on the Highway and the southbound right turn demand at Bridge Road. The modelling also indicated a substantial increase in unreleased vehicles in 2016 which indicates the extent of congestion at the Shoalhaven River bridges is such that not all of the peak hour demand is able to complete their trips on the network, i.e. by the time traffic conditions grow to this level the peak hour is likely to spread over a greater time period than 1 hour with significant impacts and delays on all major roads.

4.0 Network Improvement Options – Princes Highway

Because the Princes Highway is the only crossing of the Shoalhaven River, there is a large amount of local traffic using the Highway. The RTA and Council have therefore worked extensively together to investigate options available for managing traffic in the vicinity of the river crossing, and in particular the key section of the Princes Highway between the Bolong Road intersection and the Bridge Road intersection, including the existing Shoalhaven River bridge crossings and the intersection with Illaroo Road.

Three broad network solutions have been considered proactively and jointly between the RTA and Council over the years.

- A new bypass of Nowra – most likely to be the Future Western Bypass identified in the NBSP.
- New local crossings of the Shoalhaven River either through duplication of the existing bridges or creating new local connections to the east or west of the existing bridges.
- Intersection improvements to the 3 critical intersections on the Princes Highway at Bolong Road, Illaroo Road and Bridge Road.

It is important to keep in mind that Council is not solely responsible for the functioning of the Princes Highway, including the bridge crossing, which is primarily the responsibility of the RTA.

Further, while the RTA is currently reviewing these various options, at this stage Council is not aware of any committed funds for any upgrade works to the Princes Highway, or whether any specific improvement works have been identified for planning or subject to cost estimates.

4.1 Previous Studies of Traffic Solution Options

The RTA has previously commissioned a detailed analysis of options to address the diminishing capacity of the existing Shoalhaven River bridges. This was carried out over 2 stages.

The first investigation took place in 2004 with initial investigations into an additional Shoalhaven River Crossing. This study considered 7 options:

- An Outer Eastern Option (The Eastern Bypass)
- A Local Eastern Connection
- Relocation of the Steel Bridge
- Duplication of the Existing bridge Upstream
- A Local Western Connection
- An Intermediate Local Western Connection
- An Outer Local Western Connection (the Western Bypass)

The second investigation took place in 2005 to develop and investigate options to improve the traffic capacity of the existing bridge crossing and approaches with a view to defer the need for a new river crossing. This investigation focussed on options to improve the traffic capacity of the intersections at Bolong Road, Illaroo Road and Bridge Road.

For the road network north of the existing bridges the options included:

- An additional lane in Illaroo Road
- An Illaroo Road flyover
- An Illaroo Road/Bolong Road Interchange

A more detailed description of the options investigated, including the benefits and constraints of these options, is provided in **Appendix B**, and a summary of the benefits and constraints of each option is provided below.

4.2 Summary of Investigated Options

Table 4.1 below summarises the key benefits and constraints associated with each of the options, however the key constraint with each of these options is that they will require a funding commitment from the RTA, something which has not yet been given (see also Section 4.1).

Table 4-1: Summary of the Various Options for Alleviating Constraints on the Local Traffic Network (Princes Highway Options)

Option / Sub-option	Possible time-frame	Benefits	Dis-benefits
Bypasses			
Western and Eastern Bypass	Long-term (with costs estimated between $250M and $500M).	▪ Removes through traffic from the Princes Highway (including the Illaroo Road/Princes Highway intersection).	▪ Traffic removed from the Princes Highway is a relatively small proportion of total traffic on Shoalhaven River bridges. ▪ Does not address locally generated traffic between North Nowra, Bomaderry and Nowra City Centre. ▪ Requires long term funding commitment by RTA.
Third Bridge River Crossing (adjacent to or replacement of existing bridges)			
Local Eastern Connection	Medium to long term	▪ Separates local traffic between Bomaderry and Nowra City Centre from through traffic at the river crossing.	▪ Large bridge with high costs to address flooding constraints. ▪ Minimal benefits for Illaroo Road. ▪ Difficulty providing access from this link to Nowra CBD without substantial traffic impacts on the Highway. ▪ Requires long term funding commitment by RTA.
Bridge Duplication or Replacement	Medium to long term	▪ Increases the life of the existing Highway bridges. ▪ Would be required in any event to address structural and maintenance issues on existing southbound bridge. ▪ Not affected by flooding constraints.	▪ Traffic management problems during construction. ▪ Does not address key traffic capacity constraints at the approach intersections. ▪ Requires long term funding commitment by RTA.

Option / Sub-option	Possible time-frame	Benefits	Dis-benefits
Local western Connection	Medium to long term	▪ Separates local traffic from through traffic at the river crossing. ▪ Improved access between North Nowra, Bomaderry and Nowra City Centre.	▪ Visual impact of bridge. ▪ Direct impact on Scenic Drive foreshore developments. ▪ Does not address locally generated traffic between Princes Highway, Bomaderry and Nowra town centre without a substantial new grade separated intersections. ▪ Traffic management problems during construction. ▪ Requires long term funding commitment by RTA.
Upgrading the Illaroo Road/Princes Highway intersection (no new bridge)			
Widen Illaroo Road and create an additional left turn only lane	Short term	▪ Reduces congestion on Illaroo Road by separating north bound and south bound traffic, improving capacity for southbound right turning traffic. ▪ Improves overall intersection performance – green time allocated to Illaroo Road can be reduced considerably whilst still achieving same discharge of traffic, allowing green time to be reallocated to other Princes Highway phases. ▪ Land acquisitions required to achieve this option are likely to be required in the future irrespective of which river crossing solution is adopted.	▪ Constrained by the capacity of the Shoalhaven River bridges. ▪ Considerable land acquisition required. ▪ Requires funding commitment by RTA.
Grade Separation i.e. Illaroo Road Flyover	Medium term	▪ Substantial reduction in conflicts at Illaroo Road / Princes Highway intersection. ▪ Land acquisitions required to achieve this option are likely to be required in the future irrespective of which river crossing solution is adopted.	▪ Considerable land acquisition required. ▪ Ramp limits southbound capacity particularly if the signal phase is require to be metered to ensure safe margining of traffic downstream of the flyover. ▪ Significant impact on private properties. ▪ Requires funding commitment by RTA.

4.3 Conclusion: Network Improvement Options – Princes Highway

The relevant conclusions from the investigations are:

- The Highway capacity of the existing bridge arrangement will be reached by 2016.
- Grade-separated options at Illaroo Road/Princes Highway intersection do not substantially extend the life of the existing crossing southbound, because of the limitations on the capacity of the bridges. However, grade separated options should be considered in conjunction with all bridge enhancement options.
- There are short term intersection improvements on both sides of the existing bridges that would give some relief to congestion and provide further increases in capacity however the benefits are short term due to the capacity constraints of the existing bridges.

The short term works on the northern side of the river crossings that merits further investigation is an at-grade intersection improvement at Illaroo Road which includes widening Illaroo Road and creating an additional left turn only lane.

This improvement forms part of the river crossing relief (RCR) works on the Highway, which include a suite of intersection improvements north and south of bridges, (modelled by AECOM) and are being further considered by the RTA. However, at this stage, the RTA has not committed any funding to these Highway works improvements.

In addition RTA is continuing their investigations into options for replacement or relocation of the existing southbound bridge which has a limited operation life and has reached a point where the cost of replacement may be more viable than the ongoing costs of maintenance.

The results and conclusions from the RTA's investigations were combined with Council's TRACKS modelling information to formulate the scope of work for a robust stand-alone traffic analysis and options study of the North Nowra Link Road.

5.0 Council's Project Selection

5.1 Need for the Project

Section 2 of this EA Report clearly demonstrates that North Nowra is an area that will be the subject of significant future growth in terms of urban consolidation of existing residential areas and the development of new living areas to meet the requirements of the South Coast Regional Strategy and the Nowra Bomaderry Structure Plan.

Section 3 of this EA Report clearly identifies constraints in the local traffic network including Illaroo Road and the Princes Highway between Bolong Road and Bridge Road, taking in the Shoalhaven River bridges.

Section 4 and **Appendix B** of this EA Report summarise the network improvements that have been considered by the RTA and Council in terms of improving this section of the Princes Highway and ameliorating traffic congestion issues on the Highway itself and the connecting local roads.

The investigations carried out have identified that amelioration of traffic constraints at the intersection of Illaroo Road and the Princes Highway will require a new crossing of the Shoalhaven River or a significant upgrading of the existing bridges (i.e. new bride(s) with additional lane capacity). However, this is a long term project which would require significant funding from the RTA. In the shorter term at-grade intersection improvements have been identified north and south of the river, including at the Illaroo Road/Princes Highway intersection, to improve the performance of the Princes Highway corridor between Bolong Road and Bridge Road. This would help the RTA to defer the need for additional bridges across the Shoalhaven River, however the condition and need for decommissioning and/or replacement of the existing southbound bridge is increasingly becoming an economic consideration for RTA forcing more critical consideration of longer term requirements.

While Council has worked with the RTA over the years to investigate various options for improving key intersections of local road with the Princes Highway, in reality Council is not able to make major upgrades to the Princes Highway and its intersections, which is the role and responsibility of the RTA.

While the RTA is aware that the Shoalhaven River bridges are approaching practical capacity and are reviewing the various options, at this stage Council is not aware of any committed State funds for any upgrade works to the Princes Highway. Council is advised by the RTA that it is undertaking the additional investigations and modelling with the year 2016 being targeted due to the theoretical capacity of the bridges being reached by 2016 (governed by the capacity of the intersections immediately upstream and downstream of the bridges).

As such, Council cannot rely upon any works being undertaken on the Princes Highway by the RTA, and therefore Council is required by necessity to consider augmenting the local road network, being the only solution which is entirely within Council's control to plan and fund. Augmenting the local network involves creating an attractive alternative local road for traffic that would otherwise use Illaroo Road. This is the North Nowra Link Road concept.

5.2 Council's Project Objectives

The North Nowra/Bomaderry area currently suffers severe traffic congestion during peak periods through a combination of local traffic, congestion on the Princes Highway, and the particular configuration of the existing road network.

Council is responsible for managing traffic and safety on local roads. As part of this responsibility Council is responsible for managing traffic, safety and amenity on Illaroo Road. It is also necessary to consider in detail the operation and constraints imposed on Illaroo Road from its intersection with the Princes Highway.

Taking into account Council's responsibility to manage traffic, safety and amenity on local roads, and the network constraints that have been identified through observed evidence and traffic modelling, the North Nowra Link Road project has been developed to satisfy the following project objectives:

- To reduce congestion at the Illaroo Road/Princes Highway intersection.
- To address the existing severity of traffic problems and relieve existing traffic congestion and improve safety and amenity on more than 2 kms of Illaroo Road, which is subject to frequent congestion.
- To create a road that was determined as an important element of future infrastructure required to cater for future growth as set out in the Nowra Bomaderry Structure Plan to satisfy the over arching strategic plans. In particular, to create and maintain improved accessibility for North Nowra and for movements between North Nowra and Bomaderry.

5.3 Long List of North Nowra Link Road Options

As part of Council's initial investigations into the possible locations of a North Nowra Link Road, Council identified 11 possible North Nowra Link Road options (for the purpose of the TRACKS traffic modelling exercise) as follows:

Option 1. Connecting Illaroo Road, at Pitt Street, to Narang Road following the line of an cleared access road through the Bomaderry creek Regional Park.

Option 2. Connecting Illaroo Road via West Cambewarra Road to Moss Vale Road, opposite Elvin Drive.

Option 3. Link from Illaroo Road to Moss Vale Road as per the NBSP.

Option 4. Connecting Jamieson Road to Turley Avenue.

Option 5. Connecting Jamieson Road to West Bunberra Street via Shelter Cave.

Option 6. Connecting Illaroo Road, at Pitt Street, to West Bunberra Street via Shelter Cave.

Option 7. Connecting Illaroo Rd, between Byron Avenue and Falcon Crescent, to West Bunberra Street.

Option 8. Connecting Jamieson Road to West Bunberra Street via Clinging Tree.

Option 9. Connecting Illaroo Rd, between Byron Avenue and Falcon Crescent, to Narang Road.

Option 10. Connecting Illaroo Road via West Cambewarra Road directly to the Princes Highway at the intersection with Moss Vale Road.

Option 11. Connecting Illaroo Road via West Cambewarra Road to Narang Road.

These options are represented in **Figure 5.1**. Note that there are many more variations of these options that have also been investigated over time. However, for the purposes of the TRACKS traffic modelling exercise the important aspect of each option is the point of connection to the existing network which provides the most significant influential factor determining the outcome of traffic modelling. Depending on where they connect on to the local road network; the performance of other options can then be interpreted from review of the results of these eleven options.

5.3.1 Analysis of a Long List of Options

A benefit cost analysis for each option was undertaken to compare the respective "value for money" of each option.

To determine the benefits from each option, the assessment assumed standard values for both vehicle travel time cost and vehicle operating cost which are used to calculate the total road user benefits for each option based on that option's volumes, delays and travel speeds. The standard values have been derived from data provided by the RTA.

The estimated cost of each option takes into account all major cost factors namely land acquisition, bridge, pavement and intersection construction, and made allowance for additional minor costs and contingencies.

The benefits for each option were calculated by subtracting the "do-nothing" network benefit from each option's benefit thereby creating the overall benefit gained by building the option alignment. These benefits were then converted into a net present value by summing twenty years of benefits and discounting them by a 7% discount factor. This process was undertaken for every option for the benefits obtained from the 2006, 2016 and 2036 network analyses.

Table 5.1 presents a summary of the analysis carried out by SCC through TRACKS, the independent peer review by Gabites Porter, and a description as to why each option was either selected or rejected (the Gabites Porter independent review report is provided in **Appendix E**).

A requirement of the Nowra Bomaderry Structure Plan is the provision of a new road link between Moss Vale Road and Illaroo Road connecting the proposed new living areas to schools, shops and services in North Nowra and reducing the traffic impacts of new living areas on Moss Vale Road and the Princes Highway. Due to the location of the new areas and physical constraints of Bomaderry Creek and the Regional Park the Moss Vale Road to Illaroo Road link is too far north to provide any practical relief of traffic congestion on Illaroo Road. However, because of the proximity of that proposed new road to the NNLR options a sensitivity analysis was undertaken to determine the relative impacts of the Moss Vale Road to Illaroo Road link (MVRDLK) on the NNLR and whether or not consideration of that road would have any bearing on the modelled traffic patterns and associated benefit cost results. **Table 5.1** therefore includes the relative ranks of each of the option with and without the MVRDLK.

The results of the independent peer review by Gabites Porter are identical to those calculated by Council and demonstrate the robustness of the preliminary cost benefit analysis. However the preliminary exercise was a theoretical exercise to collect sufficient traffic modelling information about the various link options, and there are other factors that were considered to short list the general alignment options that would be subject of more detailed analysis as part of the Part 3A Concept Plan.

Figure 5-1: The Long List of Route Options for the North Nowra Link Road

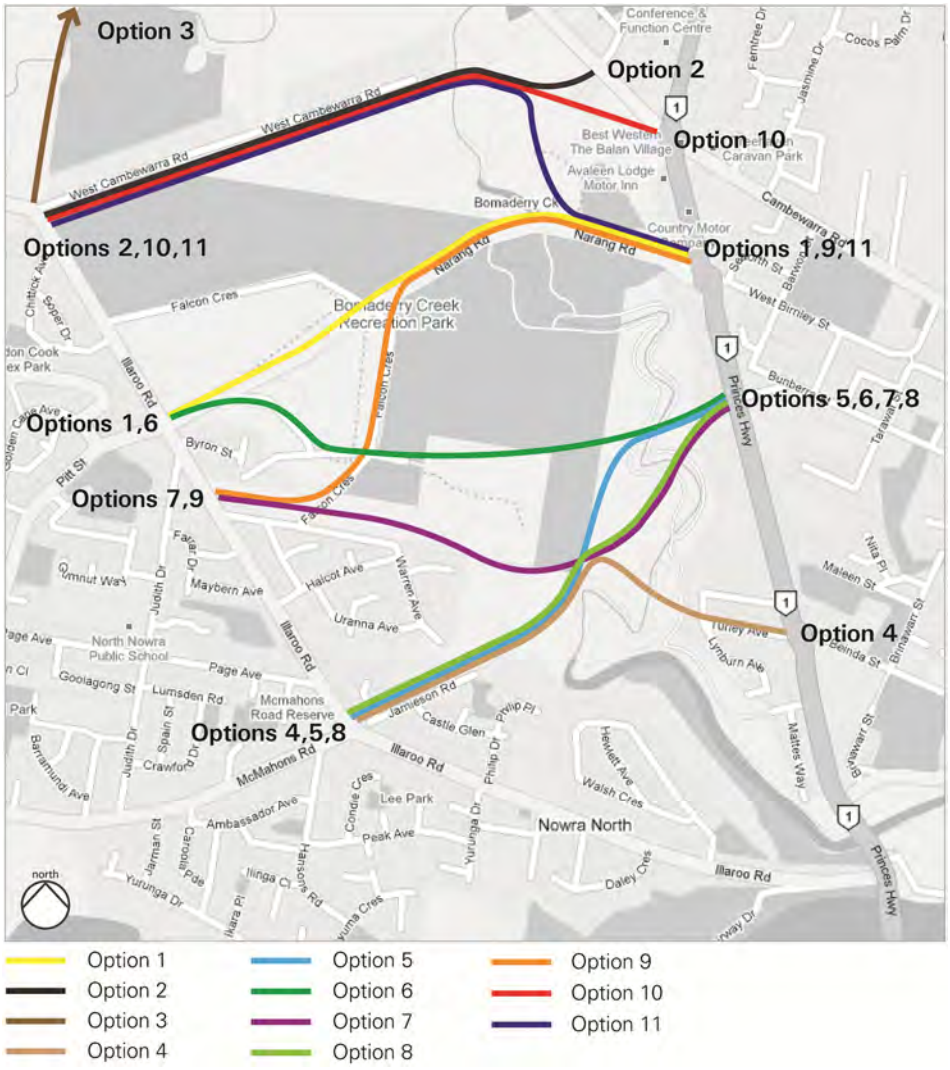


Table 5-1: Summary of the Analysis of the Long List of North Nowra Link Road Options

Opt. No.	SCC Ranking Without MVRDLK	GP Ranking Without MVRDLK	SCC Ranking With MVRDLK	GP Ranking With MVRDLK	Reason Selected or Rejected
1	1	1	1	1	Shortest route, follows existing line of existing access road and services corridor, and maximises use of existing infrastructure elements at Narang Road.
2	2	2	4	4	Follows general alignment of West Cambewarra Road with minimal impact to BCRP. This is the best performing northern option.
3	11	11	NA	NA	Does not meet the project objectives of alleviating constraints on the Illaroo Road / Princes highway intersection.
4	9	9	2	2	Impacts to existing and future residents on Jamieson Road and in the new subdivision approved by Council off Sutherland Drive and Warren Avenue. Topographically very difficult to obtain suitable horizontal and vertical alignment and would be the most expensive option to construct.
5	8	8	7	7	Impacts to existing and future residents on Jamieson Road and in the new subdivision approved by Council off Sutherland Drive and Warren Avenue.
6	5	5	6	6	More expensive than Option 1 because of private land resumption and larger bridge. Greater impact to Bomaderry Creek and walking trails, and similar impact to BCRP.
7	10	10	10	10	More expensive than other southern options, (Options 4, 5, and 8), but has fewer impacts to existing residences and private properties. While still topographically challenging it has minimal impact to the BCRP and is considered to be the best performing southern option.
8	7	7	5	5	Impacts to existing and future residents on Jamieson Road and in the new subdivision approved by Council
9	4	4	3	3	More expensive than Option 1 because of the longer distance. Same impact to Bomaderry Creek and BCRP as Option 1.
10	6	6	8	8	Is very similar to Option 2, but does not perform as well as Option 2 due to the complex intersection that would be required at the Princes Highway (it is unlikely that the RTA would support a 5 leg intersection at this location).

Opt. No.	SCC Ranking Without MVRDLK	GP	SCC Ranking With MVRDLK	GP	Reason Selected or Rejected
11	3	3	9	9	This is a combination of Option 1 and 2 and performs less well that both Option 1 and 2, as well as variations of these options, being Options 6, 9, 10. It is considerably longer than Options 1 and 2.

Note: GP means Gabites Porter, SCC means Shoalhaven City Council

Note: The three rows shaded were the options selected for the Concept Plan application.
Option 1 in the table above relates to "Option 1 (Central)" in the rest of this EAR.
Option 2 in the table above relates to "Option 3 (Northern)" in the rest of this EAR.
Option 7 in the table above relates to "Option 2 (Southern)" in the rest of this EAR.

5.3.2 Selection of Short List of Options

The key outcomes from the assessment of the long list of options are:

- **Option 1** (Pitt Street to Narang Road) is clearly the best performing option in transport economic terms (it had the highest benefit-cost ratio) and was progressed for further assessment. The other options which traversed through the centre of the Bomaderry Creek Regional Park were **Option 6** and **Option 9** which were relatively poor performers. **Option 1** follows the alignment of an existing cleared services corridor and an existing road and was the approved route from the 1993 development consent, and while it now bisects the Bomaderry Creek Regional Park, has historically been Council's preferred option for the proposed link road.
- **Option 2** (West Cambewarra Road) performed the best out of the options to the north of the Bomaderry Creek Regional Park and was progressed for further assessment. The other options which followed the general alignment of West Cambewarra Road were **Option 10** and **Option 11** which were both relatively poor performers. Being furthest to the north these options are less attractive for motorists to consider diverting from Illaroo Road, and the calculated ranking of these options reduces considerably when assessed in conjunction with the MVRDLK. However it was preferable to select a northern option for the short-list primarily because of the pre-determined need to carefully examine all potential options on the fringe of the BCRP and to ensure options that have minimal impact on the BCRP have been considered – this is of particular relevance due to the Land and Environment Court ruling of 1993 and based on consultations with the community and DECCW.
- Southern options generally attracted considerably higher traffic volumes due primarily to their closer proximity to Illaroo Road, however would be considerably more expensive than more northern options, and more challenging due to the impacts to residences, the requirement to resume private property and the challenging topography through the Bomaderry Creek Gorge.

  The comparative results for the various southern options were mixed with the Jamieson Road options **(Options 4, 5, 8)** generally performing marginally better than the option connecting Illaroo Road between Byron Avenue and Falcon Crescent **(Option 7)**. However, Jamieson Road options (**Options 4,5, and 8**) have considerable impacts on existing residents at Jamieson Road due to the road widening that would be required and the provision of private access as well direct impacts on a new subdivision recently approved by Council off Sutherland Drive and Warren Avenue.

Alignments connecting to Jamieson Road would be dictated by the very wide nature of the Bomaderry Creek Gorge and the shape of Bomaderry Creek, resulting also in a sub standard horizontal and vertical alignment. Option 4 connected to Turley Road which also represents significant impacts to existing residents due to the road widening that would be required and the provision of private access.

Option 7 could provide a suitable horizontal and vertical alignment, albeit with lower standard than achievable with northern options. Ultimately, options associated with Jamieson Road and Turley Road were rejected, and the option arising from Illaroo Road between Byron Avenue and Falcon Crescent **(Option 7)** was identified as the preferred southern option and was carried forward for further assessment. A southern option was shortlisted primarily because of the pre-determined need to carefully examine all potential options on the fringe of the BCRP and to ensure options that have minimal impact on the BCRP have been considered – this is of particular relevance due to the Land and Environment Court ruling of 1993 and based on consultations with the community and DECCW.

- **Option 3**, which is the Moss Vale Road Link to Illaroo Road, does not satisfy the project objectives, mainly because of the northern aspect of the option being far removed from the key intersection at the southern end of Illaroo Road. The Moss Vale Road Link, however, is part of the long term strategic planning for North Nowra, to provide access between the expanding area of North Nowra with the new Neighbourhood Centre and proposed high school to be located in Moss Vale Road expansion areas and part of the NBSP.

5.3.3 Three Options Selected for Concept Plan

The three options that were selected to be investigated as part of the Concept Plan were therefore:

- Option 1: Central Option
- Option 2: Southern Option
- Option 3: Northern Option

These three options were specified by the Minister for Planning in his declaration of the Project under Part 3A of the EP&A Act. It is highlighted that the gazetted declaration was based on the preliminary analysis of options described above, which adopted a centre-line approach. The Concept Plan has developed the route options in more detail as the design process has developed and further investigations have taken place. As such, it is identified that the route corridors have been refined and in some cases slightly modified from the original gazetted centre-lines shown in the Minister's declaration (the map in the Minister's declaration is shown in **Figure 1.2** and refinements to the route options are described in Section 7).

Based on the location of the three shortlisted options, a study area was selected to further investigate the potential options of a North Nowra Link Road.

The study area is described as being bounded by West Cambewarra Road to the north and Falcon Crescent to the south, with Illaroo Road and Princes Highway necessarily being the western and eastern connection points for the link road.

The key environmental attributes and constraints within the above study area are described and discussed below in Section 6.

PART B
Site Analysis and Description of Proposal

6.0 Site Analysis

6.1 Bomaderry Creek Regional Park

At the centre of the study area is the Bomaderry Creek Regional Park, covering an area of approximately 82 hectares. The Regional Park is managed by the NSW National Parks & Wildlife Service which is part of the Department of Environment, Climate Change and Water (DECCW).

This Regional Park was declared in the Government Gazette of December 2002 under Section 30H of the *National Parks and Wildlife Act 1974*. The Regional Park is considered to be an area of very high conservation value due to its high species diversity, rare and threatened flora and fauna and its high degree of use for public recreation within an expanded urban landscape. The Bomaderry Creek Regional Park contains suitable habitat for a number of threatened flora and fauna species.

The Regional Park is also of significant importance for its natural heritage, Aboriginal spiritual connection and contemporary European heritage in reference to the former dam that serviced Bomaderry for many years (the dam was partially demolished to form the existing Bomaderry Creek Weir).

The Bomaderry Creek Regional Park encompasses only a small section of the Bomaderry Creek. The majority of the creek within the study area falls within the adjacent Council land to the north and east of the Regional Park.

The Park has been developed for public recreation with a substantial public picnic ground which currently has public access only by walking. There are walking trails, interpretive signs, fences, seats, steps and handrails provided for public benefit, but the grounds are not well used due to being concealed and the access being located on a dead-end street. Examples of walkways, picnic facilities and interpretative signs installed by the NPWS are provided in **Figure 6.1**.

Walking trails are focussed around the entrance area to the Regional Park which contains facilities, and is close to the Bomaderry Creek Weir. **Figure 6.2** shows the location of facilities and walking trails within the Regional Park. There is 1 principle walking track within the Regional Park, being a 1.4 km loop that crosses Bomaderry Creek near the weir and connects again downstream (to the south) of the weir. A second walking track extends this loop to the southeast crossing onto Council owned land on either side of the Bomaderry Creek, creating a 5.5 km loop.

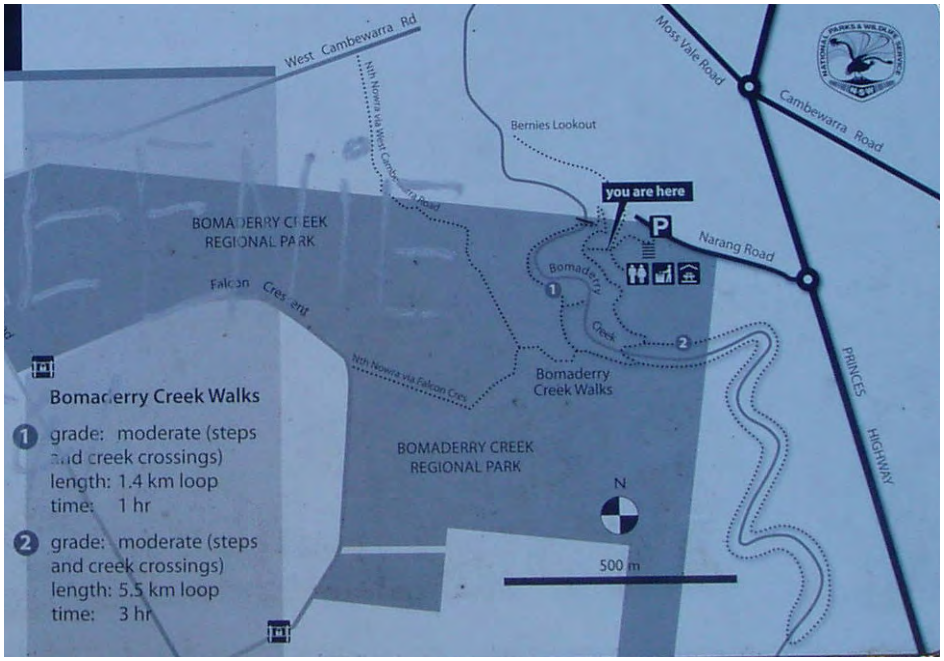
There are 3 other less significant walking tracks connecting to the principal loop trails.

- One of these connects the short loop westwards to Falcon Crescent through the Regional Park.
- A second connects the short loop – Falcon Crescent track northwards, leading the track out of the Regional Park onto Council owned land up to West Cambewarra Road.
- A third travels north from the entrance area onto Council owned land to Bernies lookout.

The Bomaderry Creek Regional Park is bounded east and north by Shoalhaven City Council land and to the west by Crown Land. Some of the Council land (i.e. the land adjacent to Bomaderry Creek) is zoned for conservation under the *Shoalhaven Local Environmental Plan 1985 (*SLEP*),* however, it does not form part of the Regional Park and subsequently is not afforded the same high level of environmental protection.

Figure 6-1: Examples of Walkways, Signs and Picnic Facilities in the Bomaderry Creek Regional Park

Figure 6-2: Location of Walking Trails in and around Bomaderry Creek Regional Park

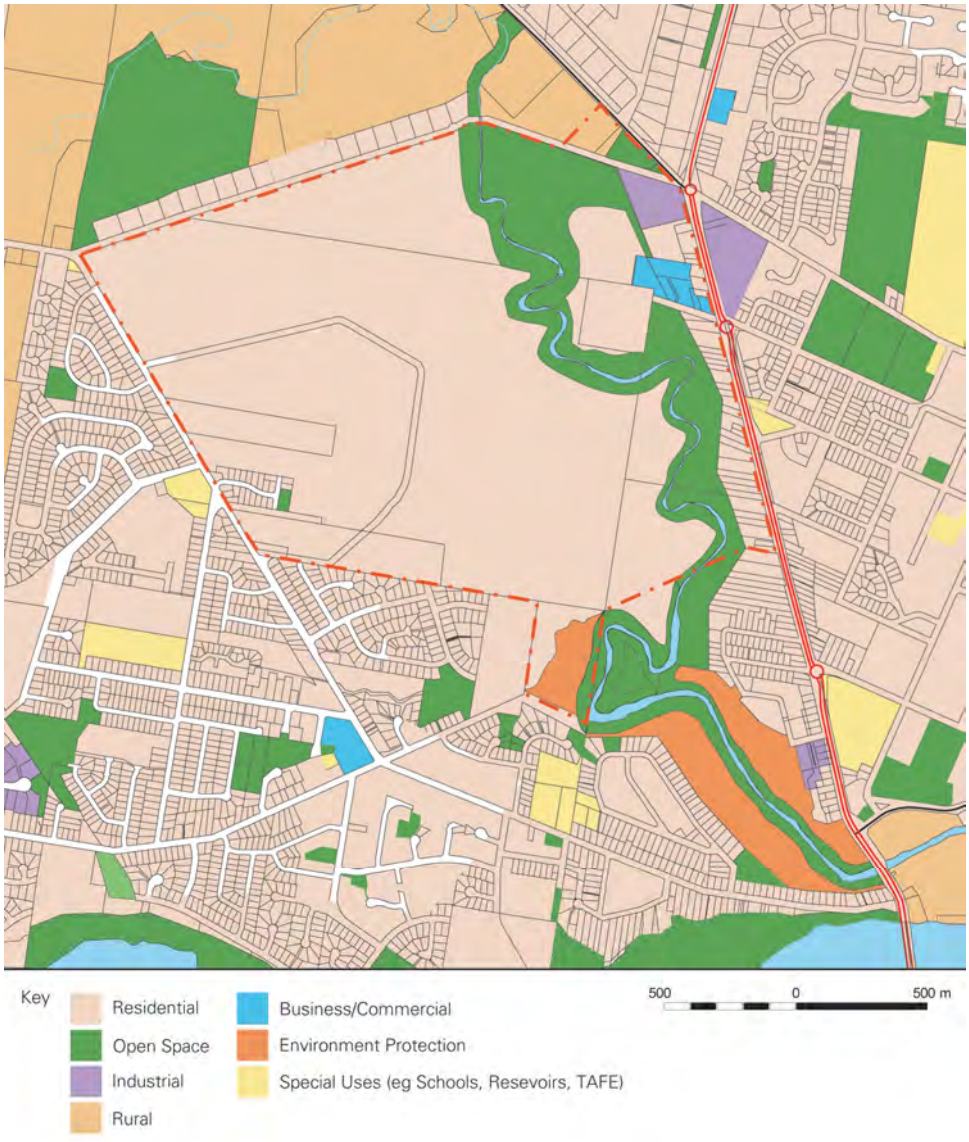


6.2 Land Ownership and Legal Description

The study area is a combination of Crown Land, Regional Park, Council owned land and private land. **Figure 6.3** shows the zoning throughout the study area.

The Regional Park is zoned a mixture of 2(c) residential and 6(c) Proposed Open Space zones under the (SLEP). Roads are permissible in these zones.

Figure 6-3: Current Zoning of the Land around the North Nowra Link Road Concept Plan



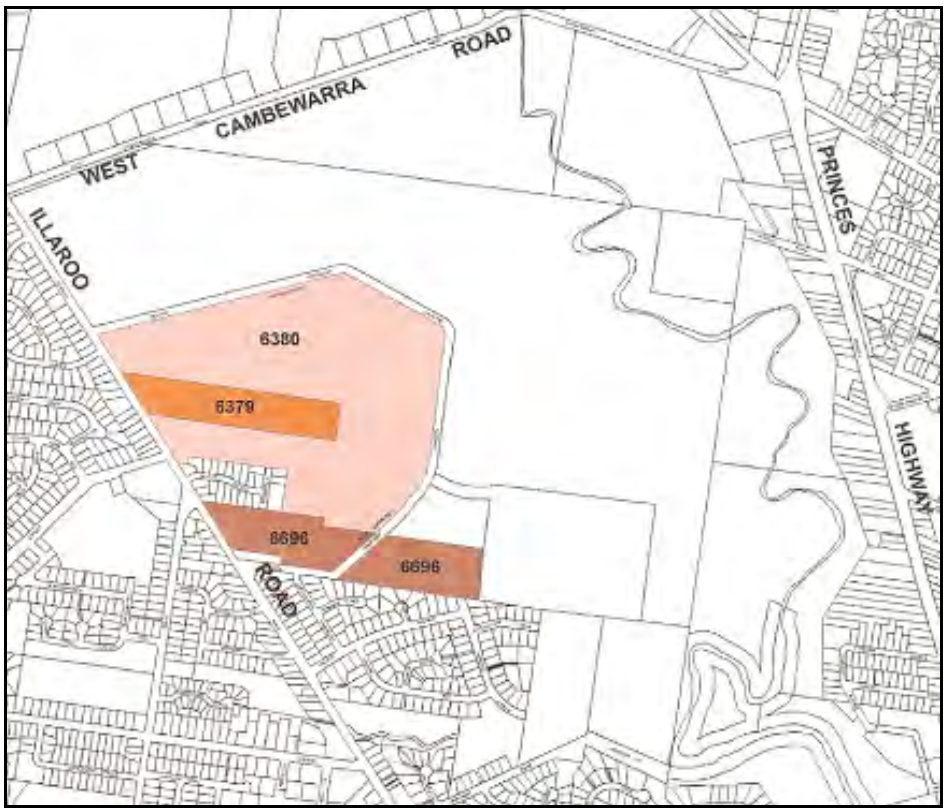
6.2.1 West of the Regional Park

Between the Bomaderry Creek Regional Park and Illaroo Road is vacant Crown Land Lot 152 DP 751258 and Lot 7312 DP 1153421.

These parcels are currently vacant Crown Land and are affected by two Aboriginal Land Claims, Numbers 6379 and 6380 that were lodged in 2000 and Claim (ALC No. 6696) lodged in 2000 which relates to land just to the south. The site areas that are subject to the Aboriginal land claims are shown in **Figure 6.4**. The Land Claims are currently being assessed by the Department of Lands.

The vacant Crown Lands to the west of the Regional Park are currently zoned Residential 2(c) under the SLEP.

Figure 6-4: Aboriginal Land Claim Areas



6.2.2 East of the Regional Park

The land immediately adjacent to the eastern boundary of the Regional Park is Council owned land which is land zoned 6(a) and 6(c), connected with Bomaderry Creek Gorge.

East of the gorge there is Council owned land zoned residential 2(c) and privately owned residential lots zoned 2(a1) along the Princes Highway.

6.2.3 North of the Regional Park

The north of the study area is generally bounded by West Cambewarra Road. In its most north-westerly the Bomaderry Creek Regional Park abuts West Cambewarra Road. When the Park was gazetted in 2002, a 10 metre wide setback was provided from West Cambewarra Road.

East of West Cambewarra Road there is a linear corridor shown on the cadastre (a paper road) which connects West Cambewarra Road with the Princes Highway at the Moss Vale Road intersection. North of this a corridor is privately owned land Lot 110, DP131219 zoned 1(b).

South of this corridor are 2 pieces of Council owned land including Lot 108 of DP 131063 and a triangular shaped parcel of land known as Lot 109, DP3060 both of which are partly zoned 6(c) and partly zoned 2(d).

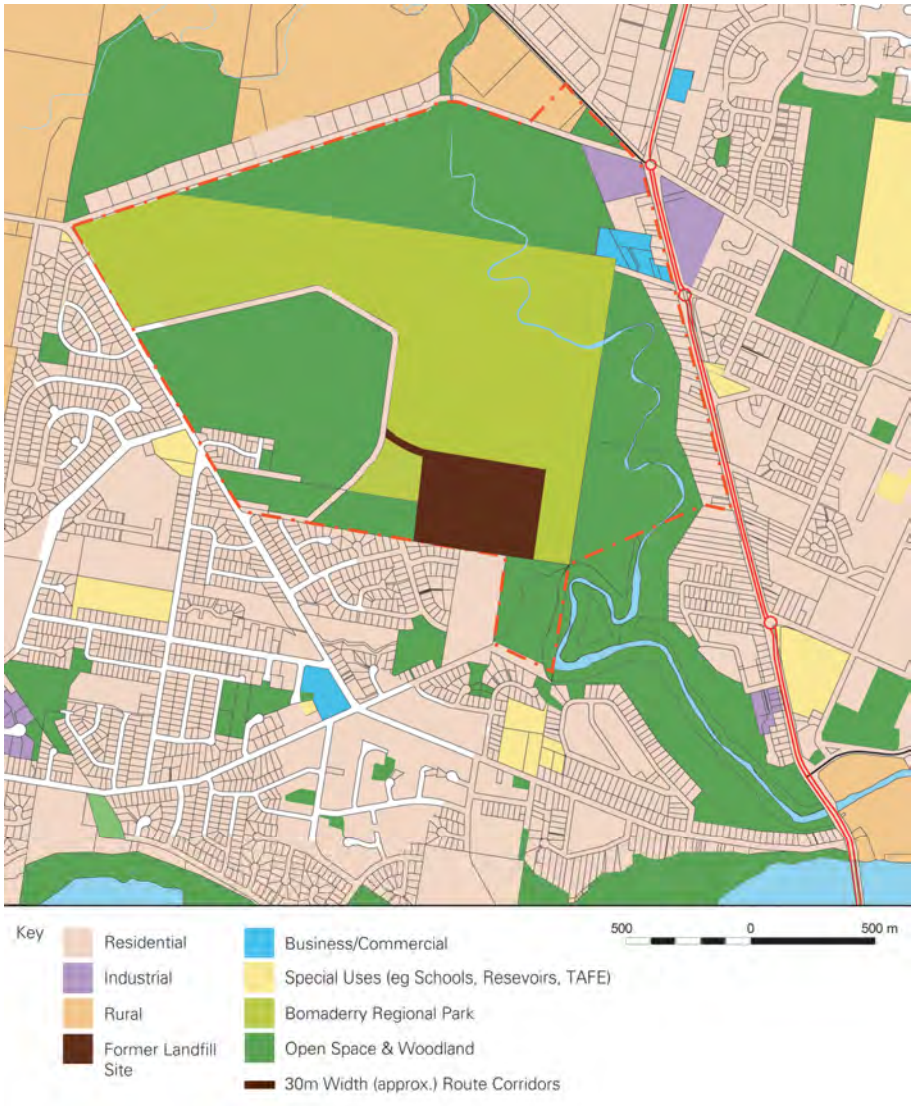
6.2.4 South of the Regional Park

To the south of the Bomaderry Creek Regional Park there is vacant Crown Land affected by Aboriginal Land claim No. 6696, Crown Land which is occupied by Council for the management of leachate from a former landfill site, Lots 118 and 119 DP751258 (Jamieson Road).

6.3 Existing and Future Land Uses

The existing and continuing land use in the study area relates is the Bomaderry Creek Regional Park. **Figure 6.5** shows the current land uses throughout the study area.

Figure 6-5: Current Land Uses for the Land around the North Nowra Link Road Concept Plan



Crossing through the middle of the Regional Park, connecting Narang Road with Illarroo Road at the Pitt Street intersection (following the Central Option alignment) is an existing cleared unsealed road which provides access to a Shoalhaven Water water main and for an Integral Energy owned 33kV transmission line. These issues are discussed further below in Section 6.3.5.

6.3.1 West of the Regional Park

The Nowra Local Aboriginal Land Council has not stated its intentions for the lands if its claims are successful and it is not statutorily required to do so.

The DECCW advised that as part of the NSW Southern Region Forest Agreement issued by the NSW Government in May 2002, the Department opposed granting the three Aboriginal Land Claims for the Crown Land adjacent to the Regional Park. This was because the areas were seen as logical extensions to the Regional Park.

Council's submissions of October 2000 and August 2002 to the Department of Lands raised no objection to the claims if the areas designated for existing and future infrastructure, including the North Nowra Link Road, were provided for, and highlights that the zoning provides for and encourages development of a range of housing types.

These lands have been identified in the NBSP as a Possible Future Living Area and are currently zoned for residential land use.

West of Illaroo Road is existing residential development associated with North Nowra, including the North Nowra Public School (primary).

6.3.2 East of the Regional Park

The Council owned land associated with the Bomaderry Creek gorge is zoned for conservation and Council currently maintains and manages the land accordingly. Because of its location immediately adjacent to the eastern boundary of the Regional Park many of the maintained recreational walking tracks currently cross over between the Regional Park and the Council owned land.

Beyond the conservation lands is housing fronting the Princes Highway, extending eastwards into Bomaderry town centre, which includes schools, the TAFE and Bomaderry Railway Station.

North of the Council owned land and east of the Regional Park is Narang Road, which currently serves as access into the Regional Park

6.3.3 North of the Regional Park

The residential zoned part of the triangular piece of land wedged between the northern boundary of the Regional Park and West Cambewarra Road is currently uncleared woodland. It has been identified in the NBSP as a Possible Future Living Area.

West Cambewarra Road is a narrow unmarked sealed road with 19 residential properties on its northern side.

Beyond the West Cambewarra Road residential area is the existing Bernie Regan Sports Complex. Council has recently built a synthetic hockey field at the Bernie Regan Sports Complex. This will be a regional facility, the only one of its kind in the Shoalhaven, and it will accommodate inter-regional competitions that will give added importance to a link road.

The land to the north and west of the existing sporting fields has been identified in the NBSP as the corridor for a future Western Bypass of Nowra, with an interchange proposed at Moss Vale Road. This area has been identified for a new school and future neighbourhood centre, sub-regional shopping centre and a Future Living Area.

Immediately north of the western Bypass corridor are two New Living Areas named Moss Vale Road South and Moss Vale Road North in the NBSP. These 2 areas are projected to accommodate up to 2,550 dwellings, more than a third of the total new dwellings planned to be provided within New Living Areas in the NBSP.

East of where West Cambewarra Road currently ends is the Bomaderry Creek gorge which is currently owned and managed by Council for conservation. The land wedged in between Moss Vale Road and Narang Road is a small area of industrial and commercial land. Within this area there are public tennis courts, a bowling alley complex, squash courts and light industrial / commercial workshops. There also exists an unformed Council owned public car park which can serve as a car park for visitors using the Bomaderry Creek Regional Park picnic ground.

6.3.4 South of the Regional Park

South of the Regional Park is Crown Land which Council has previously used as a local land fill. The land fill site is currently being rehabilitated by Council with completion scheduled for December 2010.

Beyond the Crown land and ex- landfill site are residential areas associated with North Nowra, including the Illaroo Road Public School (primary).

6.3.5 Utilities Infrastructure

Integral Energy owns 33 kV transmission lines, one is north and south along the eastern side of Bomaderry Creek and the other east west from Pitt Street to Narang Road.

The east-west transmission line is one of two primary supply lines from Nowra Transmission Substation to the Bomaderry Zone Substation. The Bomaderry Zone Substation also supplies Zone Substations at Berry and Kangaroo Valley, although there are generally contingency plans in place to cover these Zone substations from other parts of Integral Energy's network.

Integral Energy requires 24 hours access and the annual/biannual vegetation maintenance of a 16 to 20 metre wide clearance along the transmission line alignment.

Integral Energy has indicated to Council that it may need to upgrade the existing transmission line.

Shoalhaven City Council has a 600mm diameter major water trunk main from the Pitt Street Reservoir to Narang Road serving the towns of Shoalhaven Heads, Berry and Bomaderry. Access along the length of the water pipeline is required for routine maintenance and there is also a need for periodic access for major pipeline maintenance. **Figure 6.6** shows the existing crossing of the water pipeline over Bomaderry Creek.

Figure 6.7 provides elevated photographs showing the cleared services corridor.

Access is also needed to the former North Nowra waste disposal area from Falcon Crescent to service leachate ponds and to carry out general maintenance.

Figure 6-6: A Photograph of the Existing Water Pipeline Crossing the Bomaderry Creek Gorge

Figure 6-7: Elevated Photographs of the Existing Water Pipeline and Electricity Transmission Line Corridor.

Note: This Photograph is taken from west of the site, looking east towards the Bomaderry Creek Regional Park, and shows Pitt Street, Illaroo Road and the existing water reservoir in the foreground.

Note: This Photograph is taken from east of the site, looking west across the Bomaderry Creek Regional Park, and shows the existing water pipeline crossing the Bomaderry Creek Gorge in the lower right hand corner.

6.3.6 Anti-social Behaviour

There have been many recorded instances of anti-social behaviour in and around the Bomaderry Creek Regional Park of the last number of years. Records from the NSW Fire Brigade identify that between 2004 and 2007 there were 20 incidents of fire in and around the bushland which is within and contiguous with the Regional Park. It is considered likely that most of these incidents were attributable to arson. Action has been taken to prevent these incidents of arson through prevention of vehicular admittance which has served to significantly reduce anti-social behaviour and illegal activities in recent times. However, it highlights the ease with which arson activities can occur in the area which is close to urban areas but which has very limited visual surveillance.

Shoalhaven City Council has also been required to deal with burnt out cars on at least one occasion within the last few years in the vicinity of the Central Route Option.

6.4 Site Characteristics

The characteristics of the study area are provided in the following sections.

6.4.1 Geology and Landforms

The topography of the study area is characterized by an incised gorge (Bomaderry Creek) surrounded either side by a broad drainage plateau with very shallow soils over sandstone bedrock and large sandstone boulders, which are often exposed.

The underlying geology in the area is Nowra Sandstone, a coarse grained sedimentary rock which weathers to sandy and rocky soils of varying depth and low fertility. Where Bomaderry Creek passes through the gently sloping sandstone terrain, it has cut an increasingly deep gorge from the northern end, where it forms a relatively shallow depression, to the southern end which is 30 metres deep. Much interesting scenery derives from the series of deeply entrenched meanders of the gorge, cliffs, huge slabs of fallen rock and rainforest. In the lower south-eastern corner of the site the gorge forms an estuarine branch of the Shoalhaven River. The elevation of the area ranges from sea level in the south-eastern corner to 60m above sea level towards the north-west.

The gradient of the study area is generally quite level. Most of the area has a gradient in the order of 1-2%. The land steepens within 30-40m of the creek, and at the creek there are some vertical and near vertical banks which vary in height throughout the study area.

6.4.2 Soils and Land Contamination

Soils derived from the underlying sandstone are relatively coarse grained and porous, with low nutrient content. This makes them potentially liable to soil erosion when vegetation cover is disturbed.

The Shoalhaven City Council Contaminated Lands Register identifies the land surrounding the former Council landfill site adjoining the Bomaderry Creek Regional Park as being “potentially contaminated”. Council records include a memo from the Health and Community Services Division dated November 1995 that reviewed water quality testing results and concluded that contamination of surrounding lands was unlikely. The location of the former landfill site is shown in **Figure 6.5**.

Due to its elevation and geology, it is anticipated that no acid sulfate soils will be encountered during construction of any of the route options.

6.4.3 Climate

The climate of the Shoalhaven is coastal temperate characterised by warm to hot summers tempered by afternoon sea breezes and cool winters with light frosts. Rainfall averages 1,140mm per year, reasonably evenly spread, but with a slight predominance during summer to early autumn. Extremely heavy and prolonged rainfall can be a feature while extended dry periods are also common.

During autumn and winter winds are normally westerly and north westerly, which are generally strongest in the morning. During spring and summer the prevailing winds are easterlies in the afternoon.

6.4.4 Flora and Fauna

A detailed Biodiversity Assessment has been carried out by Eco Logical Australia, see **Appendix F**, and the key existing ecological features of the study area are described below.

Vegetation

The study area varies in its ecological condition and floristic diversity, ranging from barren areas devoid of ecological value to pristine undisturbed areas within the Bomaderry Creek Regional Park. The study area also contains extensive areas of land owned and managed by the Shoalhaven City Council that are of equivalent biodiversity value and quality to the Regional Park.

The Bomaderry Creek has a natural rock formation with plate-like cantilevers in parts of the riparian areas that have been identified as being used for Aboriginal shelters. Towards the southern end of the study area Bomaderry Creek passes through a deep gorge that is characterised by moist and partially alluvial soils that support a diverse range of plant species. In general, the Bomaderry Creek area has high plant species diversity, reflecting the presence of sandstone soils that usually support a high diversity of plant species, and the gorge that supports very different moist forest vegetation.

Significant vegetation communities identified within the study area were:

- Gorge Complex – Coachwood Warm Temperate Rainforest: Located in the base of the Bomaderry Creek Gorge and along the banks of the creek.
- Spotted Gum – Turpentine Tall Forest: On the upper slopes of the gorge, just below the cliff line.
- Grey Gum – Stringybark Forest/Woodland: On gentle slopes above the gorge, usually on rocky ground.
- Scribbly Gum – Casuarina Forest/Woodland: Across the plateau.
- Kunzea Scrubland: On broad rock outcrops above the gorge.
- Sandstone Sedgeland: On the plateau, on shallow, moist soils covering broad areas of bedrock.

Maps showing the location of vegetation within the study area are provided in **Appendix C** and **Appendix F**.

Critical Habitat

In 2002, the National Parks & Wildlife Service proposed that a large section of the Bomaderry Creek area be gazetted as critical habitat for the endemic species *Zieria baeuerlenii* (see below). This proposal has not to date been endorsed by the NSW Government.

Threatened Species

A search of the online EPBC Protected Matters Search Tool, and Atlas of NSW Wildlife was performed to identify threatened species that may possibly occur within the study area.

A total of twenty-eight Commonwealth and 8 State listed threatened species were identified as possibly occurring within the study area. No Commonwealth listed threatened ecological communities and one State listed Endangered Ecological Community was identified as possibly occurring within the study area.

Using databases or other records, presence or absence of suitable habitat, features of the proposed site, results of field surveys and professional judgement, the likelihood of occurrence of listed species has been determined. Those species and communities with the potential to occur or which are known to occur are discussed below.

Endangered Ecological Communities

The Endangered Ecological Community (EEC) Lowland Rainforest listed under the NSW TSC Act has been identified as having the potential to occur within the study area.

Lowland Rainforest is an ecological community of subtropical rainforest and structurally complex forms of dry rainforest. The community is usually in an undisturbed state and has a closed canopy, characterised by a high diversity of trees.

Small islands of Lowland Rainforest in the lower (southern) stretches of the Bomaderry Creek gorge could qualify as Lowland Rainforest because of the presence of subtropical species and the high plant diversity.

Threatened Plant Species

Of the 12 State and Commonwealth listed plant species identified as possibly occurring in the study area, there are 4 species considered as likely to occur or known to occur within the study area. These are:

- *Eucalyptus langleyii* (common name Albatross Mallee), listed as Vulnerable under both the Commonwealth EPBC Act and the NSW TSC Act, is known to occur within the study area. A population of *Eucalyptus langleyii* north of the Shoalhaven River, which is located within the study area, was listed as an endangered population under the TSC Act on 7 December 2010.
- *Zieria baeuerlenii* (common name Bomaderry Zieria), listed as Endangered under both the Commonwealth EPBC Act and the NSW TSC Act, is known to occur within the study area.
- *Genplesium bauera* (common name Bauer's Midge Orchid), listed as Vulnerable under the NSW TSC Act, is known to occur within the study area.
- *Hibbertia sp. Nov. 'Menai',* listed as Endangered under the NSW TSC Act in known to occur within the study area.

The known locations of threatened species within the study area are shown in **Appendix F**.

Zieria baeuerlenii

Zieria baeuerlenii is a small shrub that is restricted to a total of 57 known colonies in six discrete clusters. These clusters are confined within a 0.5 to 1.0 km area of bushland on either side of Bomaderry Creek.

The species occurs on skeletal sandy loam overlaying sandstone, on a rocky plateau amongst sandstone boulders in either shrubby open forest, shrubby woodland or closed scrub.

Seed production has never been observed in the *Zieria baeuerlenii* and all evidence collected to date suggests that the species has lost its capacity to reproduce sexually. The plants are known to resprout following fire.

Eucalyptus langleyi
The *Eucalyptus langleyi* grows to 6m tall, with smooth, grey, green or pink bark that sheds in ribbons and regenerates from rootstock after fire.

The main occurrence of the *Eucalyptus langleyi* is to the south-west of Nowra as far as Yarramunmun Creek. It is also found to a limited extent north of the Shoalhaven River in the vicinity of Bomaderry Creek. It is found in Mallee shrubland on poorly-drained, shallow, sandy soils on sandstone.

The total population of *Eucalyptus langleyi* is many thousands of plants, and some of the known stands contain several hundred specimens. A more recent study surveyed the stands to the southwest of Nowra and counted over 4,000 plants in 13 stands. Some 20 plants are currently recorded as part of the endangered population.

Genoplesium bauera
The *Genoplesium bauera* is a terrestrial orchid that grows to approximately 6-15cm in height and is yellowish-green or reddish in appearance. The species grows in sparse sclerophyll forest and moss gardens over sandstone and has been recorded from locations between Ulladulla and Port Stephens.

Surveys undertaken by the National Parks and Wildlife Service in February 2010, within the Bomaderry Creek Regional Park recorded 12 clusters containing 23 individual specimens, located near the western edge of the Bomaderry Creek Regional Park and the Crown lands.

Currently the species is known from just over 200 plants across 13 sites. This species would be considered to have a fairly broad regional distribution but individuals are usually found in highly localized populations which potentially understate the threatened nature of the species. This species grows in sparse sclerophylla forest and moss gardens over sandstone.

In addition to the individuals that were recorded in the study area, there are 3 sites approximately 5-10km west of Nowra and one site at St. George's Basin that contain this species.

Hibbertia sp. Nov. 'Menai'
This species is an undescribed one which occurs in two regions separated by over 100km one of which occurs across the Toorooroo Plateau and the second area to the west of Nowra. Little information has been recorded for the south coast population near Nowra in terms of habitat preference, longevity, seed biology and most aspects of its ecology. It appears to propagate by seed and as with most Hibbertia species it is probably pollinated by bees.

The habitat for this species appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone. Mills et al discovered a total of 45 plants that closely resemble this yet undescribed taxon within the study area.

This species is abundant in the Shoalhaven region, occurring across a large natural area west of Nowra, including thousands of plants within the Colymea State Conservation Area.

The population within the study area is extremely small in comparison to the abundance of the species to the west of Nowra, where there are possibly tens of thousands of plants.

Suitable habitat for the species within the study area was not searched systematically and it is considered that there is likely to be hundreds of plants in the area.

Threatened Fauna Species

Of the 29 State and Commonwealth listed fauna species identified as possibly occurring in the study area, there are 16 species considered to have the potential to occur or are known to occur within the study area. These are:

- 6 Bird species are known to occur, being the Gang-gang Cockatoo (*Callocephalon Fimbriatum*), the Glossy Black-Cockatoo (*Calyptorhynchus Lathami*), the Masked Owl (*Tyto novaehollandiae*), the Square-tailed Kite (*Lophoictinia isura*), the Powerful Owl (*Ninox strenua)* and the Sooty Owl (*Tyto tenebricosa*).

  All of these bird species are listed as Vulnerable under the TSC Act, but not listed under the EPBC.

  4 other bird species, being the Scarlett Robin *(Petroica boodang)*, the Flame Robin *(Petroica phoenicea)*, the Little Lorikeet *(Glossopsitta pusilla)* and the Varied Sitella (*Daphoenositta chrysoptera*), were identified as having low potential to occur within the study area. These species are listed as Vulnerable under the NSW TSC Act.
- 1 frog species being the Giant Burrowing Frog (*Heleioporus australis*), listed as Vulnerable under both the Commonwealth EPBC Act and the NSW TSC Act, has the potential to occur within the study area.
- 5 Mammal species being:
  - Large-footed Myotis (*Myotis macropus*), listed as Vulnerable under the NSW TSC Act and known to occur within the study area.
  - Spot-tailed Quoll (*Dasyurus maculates maculates* – SE mainland population), listed as Endangered under the Commonwealth EPBC Act and Vulnerable under the NSW TSC Act, has the potential to occur within the study area.
  - Grey-headed Flying-fox (*Pteropus Poliocephalus*), listed as Vulnerable under both the Commonwealth EPBC Act and the NSW TSC Act, and known to occur within the study area.
  - Yellow-bellied glider (*Petaurus australis*), listed as Vulnerable under the NSW TSC Act and known to occur within the study area.
  - Eastern Pygmy Possum (*Cercartetus nanus),* listed as Vulnerable under the NSW TSC Act has the potential to occur within the study area.

A brief description of each of these species is provided below, including details of the significance of the habitat present in the study area and likelihood of the species occurring in the study area.

Gang-Gang Cockatoo
The Gang-gang Cockatoo utilises in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests during summer, and in winter they may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.

The Gang-gang Cockatoo is known to occur within the study area and is likely to be a regular visitor to the area during the winter months when the species ranges widely. The Atlas of NSW Wildlife has records of the species throughout the Bomaderry Creek Region suggesting that the species is common throughout the area. Foraging habitat includes all areas of woodland and forest and nesting could occur in the taller forest situation in the gorge.

Glossy Black Cockatoo
The Glossy Black-Cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species occur.

It feeds almost exclusively on the seeds of she-oak species, shredding the cones with its bill. The distribution of Black She-oak is largely determined by previous disturbance. Given that the species is known to colinise disturbed areas, there is a line of feed trees occurring along West Cambewarra Road due to the previous disturbance associated with clearing. The mapped occurrence of feed trees for this species was determined by undertaking habitat surveys of the entire study area.

The Glossy Black-Cockatoo has previously been recorded in the study area and habitat suitable for the species is located at various locations throughout the site. The species is dependent on large hollow-bearing eucalypts for nest sites and one or two eggs are laid between March and August. Given the presence of nesting trees within the site, it is possible that resident breeding pairs occur.

Masked Owl
The Masked Owl occurs in undulating wet-dry forests of the coast and dry eucalypt forests of the tablelands, with optimal habitat including a mosaic of sparse (grassy) and dense (shrubby) groundcover on gentle terrain.

Roosts are located in live or occasionally dead hollow eucalypts, dense foliage in gullies and caves and recesses in cliffs.

They require mature forest or woodland with large hollow trees and dense trees or shrubs for fledglings to shelter in. Hollows greater than 40 cm wide and 100 cm deep in trees at least 90 cm diameter breast height (DBH) are used.

Masked Owls are faithful to traditional nest trees but may use alternative hollows within the breeding territory in different years. Home ranges are estimated to be 400-1000 ha, varying with habitat productivity.

It is a specialist predator of terrestrial mammals, including rodents and rabbits in disturbed areas and dasyurids in forested areas. Arboreal mammals (e.g. Sugar Glider), birds and bandicoots also supplement the diet. The species forages preferentially in ecotones within forests or along forest edges but also in open areas, and usually hunts from a perch at or near ground level, sometimes near the edges of roads.

The Masked Owl is threatened by a number of processes including habitat clearing and fragmentation, loss of mature hollow bearing trees, predation on fledglings, secondary poisoning from pesticides, disease, and being hit by vehicles. A combination of grazing and regular burning is also a threat, affecting the quality of ground cover for mammal prey, particularly in open, grassy forests.

The Masked Owl is known to occur throughout the region and has a large foraging territory. The NSW Wildlife Atlas shows that the species has previously been recorded in the Bomaderry Creek region and recent surveys recorded the species within the study area. All stands of forest and woodland within the study area provide suitable foraging habitat for the species.

It is likely that the Masked Owl is a frequent visitor to the study area. However, all stands of forest and woodland within the area only form foraging habitat for one pair of owls.

Given the habitat availability within the study area, the Bomaderry Creek Regional Park may also function as part of core permanent home range for this species.

Square Tailed Kite
The Square-tailed Kite is a reddish, medium sized, long-winged raptor which ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. It is a summer breeding migrant in the south-east, including the NSW South Coast, arriving in September and leaving by March. The species is found in a variety of timbered habitats including dry woodlands and open forest.

The Square-tailed Kite has previously been recorded within the study area and is a known summer breeding visitor to the Nowra – Jervis Bay region. There is suitable habitat for the species throughout the study area. However, this area of habitat is part of a very large foraging area for the species, covering thousands of hectares.

Powerful Owl
The Powerful Owl is the largest owl in Australasia and inhabits woodland and open sclerophyll forest, tall open wet forest and rainforest. This species has a large home range (c.450 to 1,000 hectares), and requires large areas of forest or woodland habitat in which to breed and forage, but is also known to hunt over fragmented landscapes.

The species roosts by day in dense vegetation and nests in large tree hollows, typically trees of 80 –240cm DBH. Prey items include small to medium sized mammals and birds, many of which are themselves dependant on tree hollows for shelter and reproduction.

The Powerful Owl was recorded in the north-western corner of study area during field surveys and is likely to be a frequent visitor to the study area and the Bomaderry Creek in general. Foraging habitat suitable for the species is likely to occur throughout the study area. Potential nesting trees are almost certainly restricted to the gorge area.

Sooty Owl
Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species. Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves.

The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows. The species occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. There is no seasonal variation in its distribution.

Foraging habitat suitable for the species occurs throughout the study area and the Sooty Owl was recorded in the south of study area during field surveys undertaken by Eco Logical Australia in March 2010. The species is likely to be an infrequent visitor to the study area and the Bomaderry Creek in general.

Scarlet Robin
The Scarlet Robin is a small member of the Australian robin family. The species ranges from south-east Queensland to south-east South Australia and also occurs in parts of Western Australia and Tasmania. The species is known to occur in dry eucalypt forests and woodlands where the understory is grassy with few scattered shrubs.

The study area contains small patches of vegetation that may potentially provide suitable habitat for the Scarlet Robin. However, the area predominately consists of a dense understory that lacks areas of open grassland with few scattered shrubs and therefore does not provide suitable habitat for the species. As such, if the species does occur, it is only expected to be an infrequent visitor to the area.

Flame Robin
The Flame Robin is a small member of the Australian robin family that reaches approximately 14cm in length. The species is endemic to south-east Queensland and ranges from the Queensland border to south-east South Australia. The species also occurs in Tasmania. The species is known to occur in tall moist eucalypt forests and woodlands with an open understory.

The study area contains small patches of vegetation that may potentially provide suitable habitat for the Flame Robin. However, the area predominately consists of a dense understory that lacks areas of open grassland and therefore does not provide suitable habitat for the species. As such, if the species does occur, it is only expected to be an infrequent visitor to the area.

Little Lorikeet
The Little Lorikeet is a small bright green parrot, with a red face surrounding its black bill and extending to the eye. The Little Lorikeet is distributed widely across the coastal and great divide regions of eastern Australia. NSW is known to contain a larger portion of the species core habitat. The Little Lorikeet inhabits open eucalyptus forests and woodlands and forages predominately in the canopy.

Nomadic movements are common for the Little Lorikeet and the species is often only a transient visitor to an area. The study area contains small patches of vegetation that provides suitable habitat for the species. It is only likely to be an infrequent seasonal visitor to the study area.

Varied Sittella
The varied Sittella is a small songbird with a sharp upturned bill, short tail and yellow eyes that grows to approximately 10cm in length. The species occurs across most of mainland Australia excluding areas of treeless deserts or open grasslands. Its distribution across NSW is continuous from the coastal region to the west. The species inhabits eucalypt forests and woodlands, especially those containing rough-barked species, smooth barked gums, mallee and Acacia woodland.

The study area contains small patches of vegetation that may potentially provide suitable habitat for the species. However, the majority of the study area contains vegetation that is not suitable habitat for the Varied Sittella. As such, if the species does occur, it is only expected to be an infrequent visitor to the area.

Giant Burrowing Frog (GBF)
The GBF is a large, rotund member of the Ground Frog Family Myobatrachidae reaching up to 100mm total length. It is a powerfully built species with muscular hind limbs and enlarged tubercles on the feet well suited to burrowing.

Most records for the GBF occur in dry sclerophyll forests, although it has been reported to use wet habitats for breeding sites. The species is found in heath, woodland and open forest with sandy soils.

The species has been found from near sea level up to 1000 metres, from the coast to almost 100 km inland along the escarpment of the Great Dividing Range. There is a notable disjunction in records between Jervis Bay and the Eden District, which might be due to either the rarity of the species or the limited survey effort in the region.

Across its range, the GBF appears to be dependent on areas with native vegetation as no GBF's have been recorded from cleared lands.

A single possible call was heard from within the study area in 1992. The species has never been found in the study area. However, there is potential suitable moist sandstone habitat. The total area of sub-optimal GBF habitat within the study area is approximately 13.67 hectares.

Incidental and coordinated surveys in the vicinity of the original GBF possible observation have occurred in the intervening period since 1992, and in September 2009 an inspection of the subject land was undertaken over an 8 hour period to investigate GBF habitat within the study area. A nocturnal survey was also undertaken in March 2010. During the March 2010 survey, timing and weather conditions were within the accepted parameters to enable detection of the species and the area had experienced above average temperatures and rainfall during recent months. While the survey conditions were conducive to promoting GBF activity, conditions were not optimal, which would have involved high levels of rainfall to encourage breeding (calling) activity.

While the habitat is suitable for the species, it is more limited in size and quality than other known habitat in the Shoalhaven Region (e.g. Vincentia and Booderee National Park). The potential breeding sites observed during the survey were also relatively small and would appear to be rarely inundated with water and thus providing sub-optimal breeding habitat.

While definitive conclusions on the presence of the GBF cannot be drawn on the basis of the current survey, the results of all surveys to date along with observations of habitat quality support the concept that if the GBF still occurred in the area surveyed, the population size would be extremely small. Further surveys to more reliably determine the likely presence of the Giant Burrowing Frog will take place in early 2011.

Large-footed Myotis
Large-footed Myotis is known to roost close to water in caves, mine shafts, hollow-bearing trees, stormwater systems, buildings, under bridges and in dense foliage. The species forages over streams and pools catching insects and small fish by raking their feet across the water surface. The species was previously recorded in the gorge at the southern end of the study area and may be a possible resident in this area, utilising habitat features such as the pools along Bomaderry Creek and possibly, caves where roosting could occur.

Spotted-tailed Quoll
The Spotted-tailed Quoll is a medium-sized marsupial carnivore with dark brown fur and white spots which are present on the body and tail. It occupies a range of environments within a disjunct distribution along the east coast of Australia, extending from south-eastern Queensland through NSW and Victoria to Tasmania.

This species is found in a variety of habitats, including sclerophyll forest and woodlands, coastal heathlands and rainforests. Occasional sightings are made in open country, grazing lands, rocky outcrops and other treeless areas. This species feeds on a wide variety of birds, reptiles, mammals and invertebrates and uses several 'latrines' within its territory for defecation. It is essentially terrestrial, but is also an agile climber.

Nesting occurs in rock shelters, hollow logs, caves or tree hollows and they use numerous dens within the home range. Estimates of home ranges vary from 800 ha to 20 km^2 and individuals may move several kilometres in a night. It is a highly mobile species and there are numerous records of overnight movements of several kilometres.

There are records of the species within a 10 km radius of the study area, suggesting that there is potential for the species to utilise the area. However, the presence of the species within the study area has not been confirmed by field surveys, and further surveys to more reliably determine the likely presence of the Spotted-tailed Quoll will take place in 2011.

Grey-headed Flying-fox
The Grey-headed Flying-fox is known to occur along the eastern coast of Australia from Bundaberg in Queensland to Melbourne in Victoria. Due to the high mobility of the species, there are no separate or distinct populations as individuals move between camps and throughout its geographic distribution. The most recent national count of Grey-headed Flying-fox numbers was conducted in 2005 and estimated 674,000 individuals.

The species inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. The Grey-headed Flying-fox is a canopy-feeding frugivore and nectarivore which utilise a range of vegetation types. Its primary food source is the pollen and nectar of native trees, in particular eucalyptus, melaleuca and banksia, and the species will also utilise a range of rainforest fruits. Urban gardens and fruit crops also provide foraging habitat for the Grey-headed Flying-fox.

The species roosts in aggregations of various sizes on exposed branches of trees which are often located in gullies, typically close to water, in vegetation with a dense canopy. Greyheaded Flying-fox roosting camps are generally located within 20 km of a regular food source, although they can travel up to 50 km in a night to forage.

Thirty-nine camps used by Grey-headed Flying-foxes are currently known in the south-east region of NSW, the majority of which occur along the coastal lowlands and ranges. A small number of camps in the Sydney metropolitan area are occupied continuously, and the majority of these have been established in recent years, apparently in response to increasing volumes of food in the gardens and streetscapes of Sydney. All camps associated with native vegetation in the region have less consistent patterns of occupation and the majority are occupied occasionally or rarely.

The main threat to the survival of the species is habitat loss and disturbance through the clearing of foraging habitat and roosting locations for development and farming.

Loss of important areas of habitat has also caused increased fragmentation of suitable habitat, resulting in the species having to travel greater distances for food or resorting to alternative sources such as food crops. Other threats to the species include unregulated shooting and electrocution on powerlines.

The study area is known to contain suitable habitat for the Grey-headed Flying-fox and it is identified as an itinerant visitor during the summer months to the forests in the area. Further surveys to determine if the population within the study area is a maternal camp will take place in 2011.

Yellow-bellied Glider
The Yellow-bellied Glider inhabits tall, mature moist eucalypt forests along the coast and ranges of eastern Australia. Its range extends from central Queensland to southern Victoria.

The Yellow-bellied Glider feeds primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.

They live in small family groups of two – six individuals and den in hollows of large trees. They are highly mobile with ability to glide between trees 100 metres apart and have home ranges varying between 20 hectares to 85 hectares to allow for the dispersed and seasonally variation in food resources. The study area contains a large amount of suitable habitat for the Yellow-bellied Glider which includes feed trees and denning sites suitable for the species.

The Yellow-bellied Glider has a large home range, and occurs throughout the Shoalhaven Region. The species has previously been recorded at various locations within the study area. The Grey Gum - Stringybark Forest / Woodland around the gorge is the core area of habitat for the species, however, other suitable trees within Bomaderry Creek Regional Park also serve as potential habitat.

Eastern Pygmy Possum
The Eastern Pygmy Possum is a tiny member of the possum family, growing to only 15-43 grams in weight. The species are known to be active climbers with almost bare, prehensile tails, and big forward pointing ears. The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. It inhabits a broad range of habitats including, rainforest, sclerophyll forests and woodlands and heath.

Habitat suitable for this species occurs throughout the study area. While anecdotal evidence suggests that the species has never been recorded further surveys to more reliably determine the likely presence of the Eastern Pygmy Possum will take place in 2011. Suitable habitat for the Eastern Pygmy Possum is known to occur throughout the Shoalhaven region and the area of suitable habitat that exists within the study area only represents a small portion of the overall habitat availability within the broader region.

6.4.5 Flooding

Council commissioned BMT WBM to undertake a Bomaderry Creek Flood Study to define the existing flood behaviour in the Bomaderry Creek catchment and establish the basis for upstream floodplain management activities.

The primary objective of the Flood Study was to define the flood behaviour of the Bomaderry Creek catchment through the establishment of appropriate numerical models. Central to this was the development of a two-dimensional hydraulic model of the floodplain incorporating both the upper catchment around Cambewarra and lower catchment around Bomaderry. The study has produced information on flood flows, velocities, levels and extents for a range of flood event magnitudes under existing catchment and floodplain conditions.

Historical Flooding

Much of the data relating to historical flooding in the Bomaderry Creek catchment is associated with major flooding in the Shoalhaven River system.

Major events in the Shoalhaven River catchment include 1860, 1870, 1873, 1916, 1925, 1974, 1975, 1978, 1988 and 1990. These events largely impacted on the lower floodplain of Bomaderry Creek, south of the study area.
Peak water level records at Nowra Bridge and at industrial property along Bolong Road provide a good record of flood history dominated by the Shoalhaven River. However, there is very little existing flood data for the upper catchment of Bomaderry Creek.

Since 2003, the NSW Dept. of Water and Energy (DWE) has operated a streamflow gauge on Bomaderry Creek just upstream of the entrance to Bomaderry Gorge, just to the north of West Cambewarra Road.

However, during this time only minor flood events have occurred, with the highest event occurring in February 2008 estimated to be of the order of a 5-year return period.

Flood Modelling

Development of hydrologic and hydraulic models has been undertaken to simulate flood conditions in the catchment. With consideration to the available survey information and local topographical and hydraulic controls, a hydraulic model was developed extending from the Shoalhaven River confluence at the downstream limit, to approximately 14km upstream along the major tributary routes, comprising a total area of some 22km2 which represents the lower 60% of the entire Bomaderry Creek catchment.

A reasonable model calibration has been achieved given the limited data available for the catchment. The developed models are considered to provide a sound representation of the flooding behaviour of the catchment, as demonstrated through comparison of recorded peak water levels for the historical events simulated.

The study establishes the design flood conditions and is considered to provide the best available information to inform of potential flood risk and set appropriate planning and development controls to accommodate this future development within the catchment.

Results

The highly incised steep and narrow gully through Bomaderry Gorge is a significant topographical feature in the catchment affecting flood behaviour.

North of the entrance to Bomaderry Creek Gorge, the natural topography is generally flat with a widening of the floodplain and a corresponding increase in design flood inundation extents and flow depths.

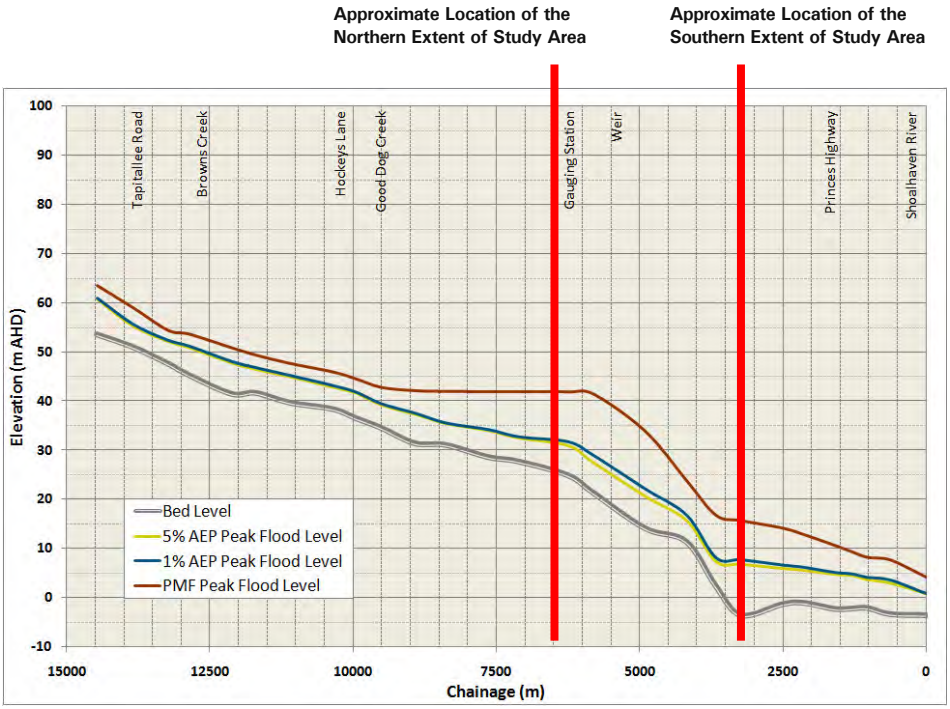
The broader floodplain area to the north becomes active floodplain in major events. Flooding in this region is exacerbated by the natural control formed by the constriction at the entrance into the Bomaderry Creek Gorge, where out-of-bank flooding occurs for the major design events and there is extensive backwater influence.

South of the entrance the Bomaderry Creek Gorge is a highly incised, steep sided and narrow valley. The hydraulic control imposed by the Bomaderry Creek Gorge effectively separates the lower floodplain of Bomaderry Creek from the middle and upper parts of the catchment. **Figure 6.8** shows the approximate location of the stud area in relation to the elevation levels of the bed of Bomaderry Creek and the modelled flood levels. The figure shows clearly steepness of Bomaderry Creek through the study area.

Flood extents are limited within the Gorge driven by the natural topography, with no impact on adjacent development sited on the higher ground along the Princes Highway. There is a low flow weir within the Bomaderry Creek Gorge reach, its location shown in **Figure 6.8**. At flood magnitudes however, the structure would effectively to be drowned out and given the steepness of the channel, the hydraulic effect of the weir does not extend beyond the Gorge reach even for low flow regimes.

As expected in the Bomaderry Creek Gorge, the steep narrow channel section exhibits high peak flow velocities under design flood conditions. Flow velocities in excess of 5m/s may be expected in the steepest sections of this reach.

Figure 6-8: Longitudinal Cross-Section of Bomaderry Creek, showing the significant elevation drop across the study area.



Source: Bomaderry Creek Flood Study, Preliminary Draft Report R.N1267.001.00, November 2009, BMT WBM

6.4.6 Bushfire Hazards

The site is "bushfire prone" land. In 1998, Shoalhaven City Council and the Department of Land and Water Conservation prepared a Bushfire Management Plan in light of a history of illegal fires in the area and their potential impact on residential properties to the east. The planned actions included public education on the importance of bushland, greater ranger surveillance, maintenance of fire trails and limiting unauthorised access with barriers which can be opened for operational purposes.

In June 2005, the NSW Department of Environment and Conservation (National Parks and Wildlife Service) prepared a draft fire management strategy for Bomaderry Creek Regional Park. It was publicly exhibited in 2005/06 and has now been finalised. The Fire Management Strategy presents operational guidelines to assist fire management activities and draws attention to wildlife, known rare or threatened plant species and aboriginal cultural sites.

6.4.7 Aboriginal Heritage

Shoalhaven City Council commissioned Kelleher Nightingale to carry out an Aboriginal Heritage Assessment report for the North Nowra Link Road project. The report is provided in **Appendix G,** and a summary of the existing Aboriginal heritage in the study area is provided below.

Consultation with the local Aboriginal community was also undertaken and is described in **Section 9.4.**

Aboriginal Cultural Values

It has been clearly identified that the study area has cultural heritage value to the local Aboriginal community. Some of the Aboriginal cultural heritage values expressed by Land Council representatives include:

- strong association with the land;
- responsibility to look after the land, including the heritage sites, plants and animals, creeks and the land itself;
- rock art;
- artefact sites and landscape features;
- creek lines;
- Indigenous plants and animals; and
- general concern for burials, as their locations are not always known and they can be found anywhere.

Ethnohistoric Background

Ethnohistoric information can be valuable in understanding the nature and extent of Aboriginal cultural heritage. Although no direct ethnographic recordings relate to the Bomaderry Creek area, it is evident that Aboriginal people and families occupied the extended Shoalhaven River region with particular importance attributed to places like Bomaderry Creek. These places are likely very significant to Aboriginal people as they are high biodiversity areas exhibiting multiple resource zones.

Based on Kelleher Nightingale's surveys and general ethnographic information Bomaderry Creek and Gorge clearly have value to past and current Aboriginal people.

Aboriginal Archaeology

Known Aboriginal archaeology within or near to the study area was identified through searches of the DECCW Aboriginal Heritage Information Management System (AHIMS).

Sites associated with outcropping sandstone were the predominant site type in the vicinity of the study area. From the AHIMS site search results (8th October 2007), there were 14 recorded sites within 100 m of Bomaderry Creek, stretching the length of the study area from north to south.

Archaeological surveys were also conducted along each route and within at least a 50 metre corridor on either side of each route. In accordance with the DGRs, both the eastern and western sides of Bomaderry Creek Gorge were also surveyed from the northernmost route, West Cambewarra Road, to the southernmost route, Illaroo Road to West Bunberra Street. Each site was recorded and assessed using archaeological recording techniques for sites of Aboriginal heritage. This included site descriptions, site locations, scaled site plans and profiles, as well as inventories and photos of cultural features located at sites.

The assessment of site conditions included an archaeological assessment of the integrity and intactness of each cultural feature type.

An overall site condition summary was then allocated to each site as either being in Good, Moderate or Poor condition.

- Good Condition: Sites with this rating demonstrated high integrity and intactness of the cultural features observed.
- Moderate Condition: Sites with this rating showed damage from human impacts or natural weathering to many or all of the cultural features but the features are still discernible. Sites with these criteria may include sites that have one or more cultural features intact but other features weathered or degraded.
- Poor Condition: Sites with this rating demonstrated low integrity and intactness of the cultural features observed. The cultural features may be highly disturbed by natural or non-natural agents. Many of the sites assessed as being in poor condition showed a high degree of human impact in the form of rubbish, graffiti, disturbance to deposits and other acts of direct or indirect site vandalism.

An assessment of the scientific significance of each site was also provided using criteria to evaluate the contents of a site, state of preservation, integrity of deposits, representativeness of the site type, rarity/uniqueness and potential to answer research questions on past human behaviour.

- High significance is usually attributed to sites which are so rare or unique that the loss of the site would affect our ability to understand an aspect of past Aboriginal use/occupation of an area. In some cases a site may be considered highly significant because it is now rare due to destruction of the archaeological record through development.
- Moderate/Medium significance is attributed to sites which provide information on an established research question.
- Low significance is attributed to sites which cannot contribute new information about past Aboriginal use/occupation of an area. This may be due to site disturbance or the nature of the site's contents.

The outcomes of the database searches and the surveys are presented in **Table 6.1** and the location of each site is shown in **Figure 6.2**.

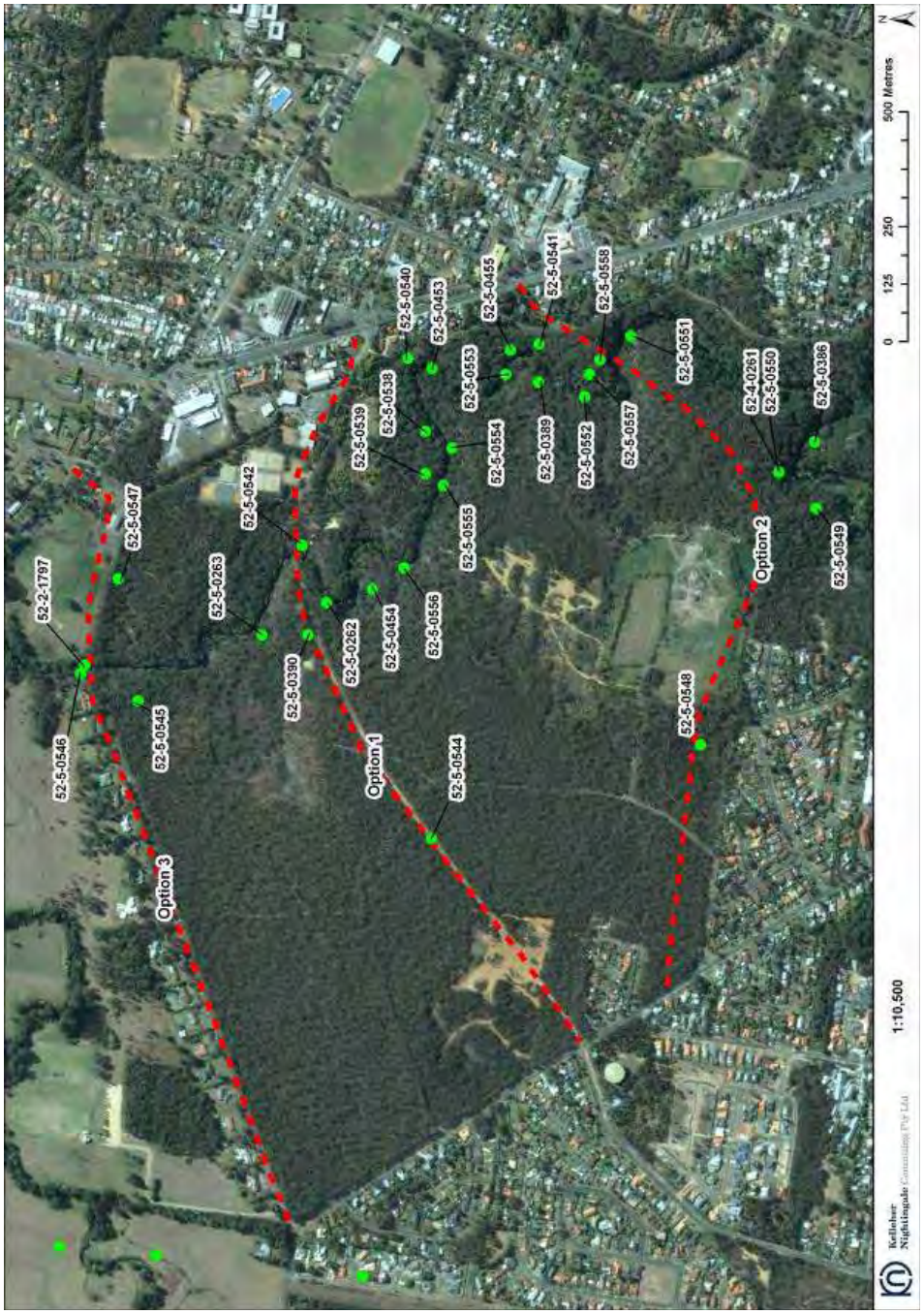
Table 6-1: Identified Aboriginal Heritage Sites

Report ID	AHIMS ID	Description	Condition	Archaeological Significance
BCRP 001	52-5-0538	Occupation Shelter with Art Large sandstone shelter approximately five metres above Bomaderry Creek	Poor	Moderate
BCRP 002	52-5-0539	Occupation Shelter Sandstone shelter located approximately 20-30 metres above Bomaderry Creek	Poor	Low
BCRP 003	52-5-0540	Open Site Midden Shell midden exposure scattered over 40 metres along eastern side of Bomaderry Creek	Poor	Low
BCRP 004	52-5-0453	Occupation Shelter/Art Long sandstone shelter in Bomaderry Creek gorge with art and artefacts	Moderate	Moderate
BCRP 005	52-5-0541	Occupation Shelter Very shallow shelter formed by leaning cliff line along the eastern side of Bomaderry Creek walking track	Moderate	Low
BCRP 006	52-5-0542	Occupation Shelter/Midden Sandstone shelter with bedrock floor 30 metres south (downstream) of the water pipe and power lines that traverse Bomaderry Creek gorge	Poor	Low
BCRP 007	52-5-0543	Open Site Artefact Scatter This site consists of a small scattering of shell fragments and artefacts on a sandy terrace two metres above Bomaderry Creek	Moderate	Low
BCRP 008	52-5-0454	Occupation Shelter/Art Sandstone shelter located on western side of Bomaderry Creek approximately 150-200 metres downstream from Narang Road	Poor	Low
BCRP 009	52-5-0262	Occupation Shelter Sandstone shelter located on western side of Bomaderry Creek approximately 50-75 metres downstream from Narang Road	Poor	Low
BCRP 010	52-5-0263	Occupation Shelter Sandstone shelter located on western side of Bomaderry Creek approximately 150-200 metres upstream from Narang Road	Poor	Low
BCRP 011	52-5-0390	Open Site Artefact Scatter Two isolated flake pieces on the service road that runs along the power lines through Bomaderry Creek reserve	Poor	Low

Report ID	AHIMS ID	Description	Condition	Archaeological Significance
BCRP 012	52-5-0544	Isolated Find One isolated red fine grained siliceous core located on the service road that runs along the power lines through Bomaderry Creek Reserve	Poor	Low
BCRP 013	52-5-0545	Open Site Artefact Scatter This site is located on a foot track that runs off the south-east end of West Cambewarra Road	Poor	Low
BCRP 014	52-5-0546	Open Site Artefact Scatter This site is located on the foot track that runs off the end of West Cambewarra Road to Bomaderry Creek. The foot track cuts approximately 50 centimetres into a creek terrace one-two metres above Bomaderry Creek. Artefacts are exposed in the sides of the erosion banks on the track up to 20 metres along the terrace. More than 20 artefacts were observed including artefacts made from red fine grained material, grey silcrete, and a pale white fine grained material	Moderate-Poor	Moderate
BCRP 015	52-5-0547	Isolated Find This site is located on the foot track in Bomaderry Creek Reserve adjacent to the North Nowra Sale Yards.	Poor	Moderate
BCRP 016	52-5-0548	Not Aboriginal Heritage Site (Recent Scar Tree) Recently completed scar tree in Bomaderry Creek Reserve, approximately 5 metres south of the Illaroo Road-West Bunberra Street option for the North Nowra Road Alignment	NA	Low
BCRP 017	52-5-0549	Occupation Shelter Sandstone shelter located approximately 300 metres east of the end point of Warren Avenue, North Nowra	Moderate	Low
BCRP 018	52-5-0386	Occupation Shelter Very large row of sandstone shelters on a bend along the western side of lower Bomaderry Creek	Moderate	Moderate
BCRP 019	52-5-0551	Occupation Shelter Small sandstone shelter on a detached boulder from the cliff line on the western side of Bomaderry Creek	Moderate	Low
BCRP 020	52-5-0552	Occupation Shelter Sandstone shelter formed by leaning cliff line on the western side of Bomaderry Creek gorge	Moderate	Low

Report ID	AHIMS ID	Description	Condition	Archaeological Significance
BCRP 021	52-5-0389	Occupation Shelter Sandstone shelter on the western side of Bomaderry Creek gorge	Moderate	Low
BCRP 022	52-5-0552	Occupation Shelter Sandstone shelter on the western side of Bomaderry Creek gorge	Poor	Low
BCRP 023	52-5-0554	Occupation Shelter/Art Sandstone shelter on the western side of Bomaderry Creek gorge	Poor	Low
BCRP 024	52-5-0554	Occupation Shelter Small sandstone shelter on the western side of Bomaderry Creek gorge.	Poor	Low
BCRP 025	52-5-0556	Occupation Shelter Long sandstone shelter on the western side of Bomaderry Creek gorge	Moderate	Low
BCRP 026	52-5-0557	Occupation Shelter Sandstone shelter on the eastern side of Bomaderry Creek gorge, directly below the Illaroo Road-West Bunberra Street option for the North Nowra Road Alignment	Poor	Low
BCRP 027	52-5-0558	Occupation Shelter Large sandstone shelter on the eastern side of Bomaderry Creek gorge, close to the Illaroo Road-West Bunberra Street option for the North Nowra Road Alignment	Moderate	Moderate
BCRP 028	52-2-1797	Axe Grinding Groove 10 axe grinding grooves located adjacent to Bomaderry Creek. Some destruction from construction of neighbouring road bridge.	Moderate	Moderate

Figure 6-9: Location of Known Aboriginal Heritage Sites

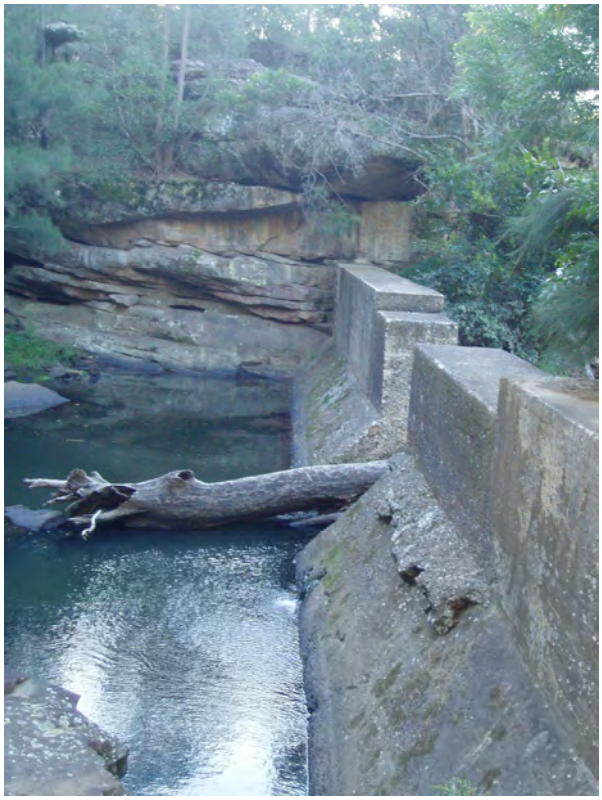


6.4.8 European Heritage

In 1937 Berry Municipality built a water supply dam on Bomaderry Creek to serve the Bomaderry residential and commercial areas. The dam was subsequently partially demolished to allow fish to migrate upstream. This remnant forms a weir that survives to the present day (which is shown in **Figure 6.10**), including associated extant features of the foundations of the pumping station, part of the pipeline with concrete pedestals and scattered artefacts.

The only item or place of European heritage significance is the Bomaderry Creek weir and associated relics. This is listed in the Shoalhaven Heritage Study as Item NB 126 and assessed as having local significance.

Figure 6-10: The Bomaderry Creek Weir



6.4.9 Air Quality

The air quality monitoring stations established as part of the Nowra Bomaderry Structure Plan indicate that background air quality in the Shoalhaven is excellent, well above both current and proposed standards.

An occasional issue is the existence of unpleasant odours in the Bomaderry area. Records from Shoalhaven City Council confirm that odour complaints to 2006 only contributed 7% of environmental complaints received for the Shoalhaven.

6.4.10 Noise

The AECOM report (**Appendix E**) contains a noise assessment for the North Nowra Link Road. The noise assessment included the monitoring of background noise at selected sensitive receivers in the study area.

Unattended noise loggers were used to continuously measure ambient noise levels at representative receivers in the surrounding areas. A noise logger measures the noise level over a sample period and then can determine average noise levels in the environment or noise levels that are exceeded for certain percentage of the time. Of particular interest are the $L_{A,90}$ and the $L_{A,eq}$.

- The $L_{A,90}$ is taken as the background noise level. It is the noise level which is exceed for 90% of the sample period.
- $L_{A,eq}$ is the equivalent continuous sound level and has the same energy over a sample period as the actual noise environment which has fluctuating sounds levels.

Table 6.2 below presents the ambient noise levels ($L_{A,eq}$ and the $L_{A,90}$) for each of the field logger locations at different times. The major ambient noise sources in the area are road traffic noise, apart from 11 Sutherland Drive which is located approximately 500 m from Illaroo Road, where the noise levels appeared to be dominated by noise emissions associated with the residence.

Table 6-2: Existing Ambient Noise Levels

Location	Rating Background Level (LA,90)			LAeq 1 hr	
	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)	Day	Night
3 West Cambewarra Road	34	34	33	49[2]	47[2]
9 Byron Avenue	37	33	29	50[2]	43[2]
11 Sutherland Drive[1]	34	47	43	52[2]	51[2]
Illaroo Road Public School	52	41	36	70[2]	64[2]
45 Illaroo Road	54	44	30	73	67

Note 1: The noise levels at this location appear to be dominated by noise emissions from the property.
Note 2: Freefield (with no façade correction).

Logging of existing traffic noise levels was not conducted in the woodland areas. In these types of areas, well away from traffic noise, measurements are often affected by extraneous noise from wildlife and wind induced noise in trees. For this reason the calibrated noise model has been used to identify the existing traffic noise contribution within the recreational areas rather than unattended logging. This is a widely used method of determining noise level contributions when logged data is affected by other noise sources.

The background noise monitoring was carried out to provide data in order to validate the noise model prepared by AECOM for the noise assessment. Location of field loggers were selected to provide a good coverage of field data at locations that may be noise sensitive to changed traffic patterns as consequence of the link road options and this has also ensured a high level of validation of the noise model. Noise monitoring was not undertaken east of Bomaderry Creek as the road traffic flows, and hence road traffic noise levels, were not predicted to change as substantially as on nearby roads such as Illaroo Road, West Cambewarra Road and the Link Road and therefore these locations were used in preference to the Princes Highway.

6.4.11 Surface and Ground Water

Surface Water Quality

The main water body in the study area is Bomaderry Creek which is a tributary of the Shoalhaven River.

Water quality data were obtained from Shoalhaven City Council's regular monitoring of local river and creek systems, which formed part of the Nowra Bomaderry Structure Plan.

Bomaderry Creek is monitored upstream and downstream of the study area and at one station within the Regional Park. Bomaderry Creek maintains a continual flow, even in dry weather conditions.

Results published in early 2005 in the Nowra Bomaderry Structure Plan confirm all tested parameters were well within published guidelines. Testing continues as part of Shoalhaven City Council's regular monitoring and State of Environment Report protocol. The April 2006 testing results for Bomaderry Creek confirmed that water quality remained within the guidelines, except for phosphorous which marginally exceeded the 0.05mg/L guideline.

Ground Water Quality and Contamination

There is no published data for local ground water quality. The absence of large scale industry in the locality makes it unlikely that existing groundwater resources have been contaminated.

The Shoalhaven City Council Contaminated Lands Register identifies the land surrounding the former Council landfill site adjoining the Bomaderry Creek Regional Park as being "potentially contaminated". Council records include a memo from the Health and Community Services Division dated November 1995 that reviewed water quality testing results concluding that contamination of surrounding lands was unlikely.

7.0 Description of the Concept Route Options

The proposed road is conceptual and its actual alignment will be subject to design development. As such a limited amount of design has taken place at this time. The Concept Plan identifies road corridors within which an indicative road alignment has been prepared. The proposed road corridor and indicative alignment for each option have been prepared with regard to the following key parameters:

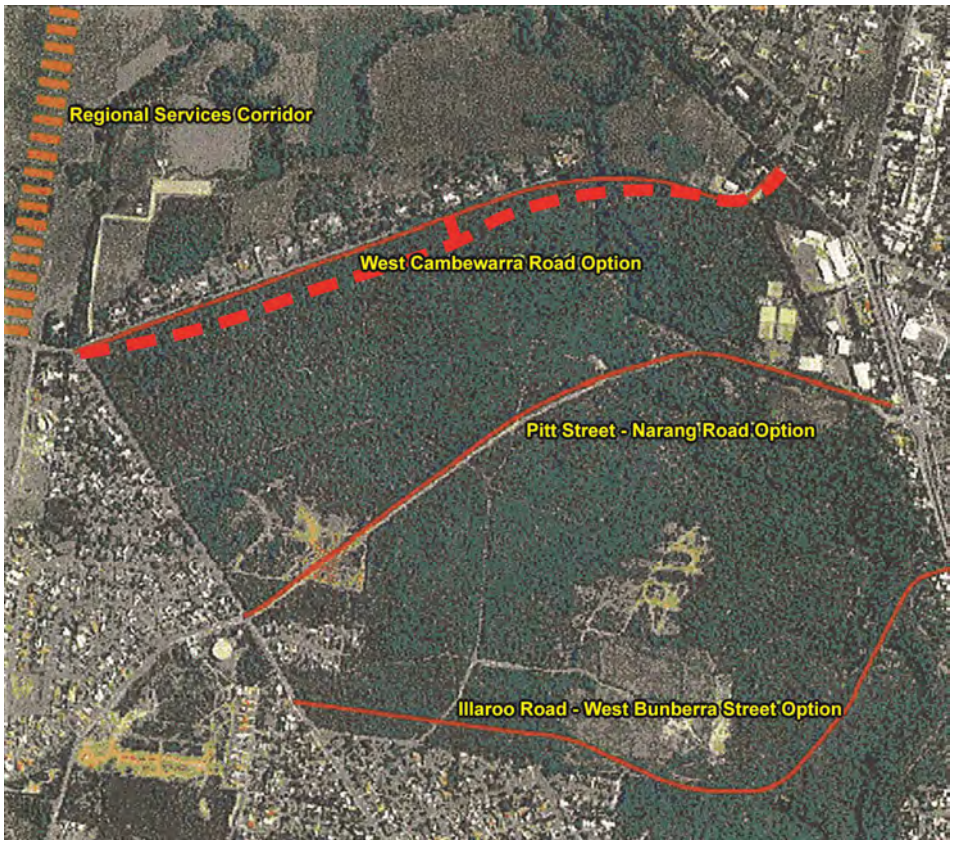
- General consistency with the route options gazetted by the Minister for Planning as part of the Part 3A declaration.
- Road design standards that dictate the width and alignment of the proposed road.
- Indicative bridge design which affects the alignment in the vicinity of the crossing of the Bomaderry Creek Gorge.
- Consideration of environmental factors such as minimising or avoiding impacts, where possible, to native vegetation, threatened species and archaeology or heritage items.
- Local access design considerations.

Appendix C provides Concept Plan drawings for the 3 route option corridors. It is highlighted that the three options, specified by the Minister for Planning in his Part 3A declaration of the Project, were based on the preliminary analysis of options using a centre-line approach. Council has developed the route options in more detail during the preparation of the Concept Plan as the design process has developed and further investigations have taken place. As such, the route option corridors have been refined and in some cases slightly modified from the original gazetted centre-lines shown in the Minister's declaration (the map in the Minister's declaration is shown in **Figure 1.2**). In particular it is identified that the centre-line of Option 3 (the Northern Option) has been shifted to the south for safety and amenity reasons, as shown in **Figure 7.1**. The reasons for this change are described in more detail in Section 7.5.

In addition to describing the key road and bridge design parameters, for each route option, the following sections describe the key parameters for each route option, including:

- The total length of the route option.
- The design speed (Note: the design speeds have been assumed for the design and technical assessments following initial discussions with RTA, however post opening of the link road actual sign posted speeds are the responsibility of the RTA).(Note: In terms of the detailed traffic modelling and analysis a consistent 70 km/hour speed limit was applied to each of the three route options).
- Indication of the proposed changes to intersection treatments.

Figure 7-1: Proposed Refinement to Option 3 – the Northern Option



7.1 Road Design Standards

The road will consist of two lanes, each 3.5 metres wide with 2.5 metre shoulders (of which 2 metres would be sealed) complying with AUSTROADS Rural Road Design Guidelines and Cycleway Standards. A typical photograph of such a road is given in **Figure 7.2**.

In addition to the road itself, sufficient room will be needed for earthworks, clear zone, batters, drains and embankments. A nominal corridor width of 30 metres has been adopted so that the road alignment can be adjusted during design development to minimise environmental impacts and to account for more detailed investigations of ground conditions.

The proposed road is to be a sub-arterial road which will not permit individual private accesses. The Concept Plan drawings provided in **Appendix C** show the proposed corridor within the red lines. Within each corridor is an indicative road footprint, which will be subject to detailed design.

All route options would require a new or upgraded intersection at the Illaroo Road end.

The details of landscaping proposals will be determined as part of the detailed design, including visual and noise mitigations measures. Landscape planning will use endemic species which require minimal maintenance.

Figure 7-2: View of a 2-Lane Road

7.2 Bridge Design

All options would include a new bridge over Bomaderry Creek.

Bridges would have a reduced 2 metre sealed shoulder on either side of the traffic lanes and a minimum 1.8 metre wide shared path on the southern side. A minimum freeboard of 500mm would be used to the underside of the bridge deck as required by Shoalhaven Development Control Plan 100. All crossings would be designed to provide flood free access during a once in 100 year Average Recurrence Interval flood event. The bridges would be constructed of prestressed concrete.

All bridge designs are indicative at this Concept Plan phase of the Environmental Assessment. Council would seek not to exceed 35 metres in any single span during the detailed design.

An indicative Concept Plan design for the bridge for each option has been prepared by Jim Alexander Bridge Design, and is provided in **Appendix D**.

7.3 Option 1: Central Route Option

The Central Route Option would link Illaroo Road and the Princes Highway between existing intersections at Pitt Street and Narang Road, following an existing cleared corridor which contains an unsealed services road and electricity transmission line between Pitt Street and Narang Road.

7.3.1 Central Option – Design and Bridge Parameters

The road would have a general design speed of 80 kph, though at either end this would be reduced to the sign posted speed of the adjoining roads for an appropriate length to improve safety, currently 60 kph at the west end (current sign posted speed on Illaroo Road), and 50 kph at the east end (current sign posted speed on Narang Road), although this could be increased to be more consistent with the sign posted speed limit on the Princes Highway at 70 km/hour. Total pavement length would be approximately 1,810 metres although east of Bomaderry Creek the land is already predominantly cleared and a formed road.

The bridge would conceptually be a three span structure with a total length of about 75 metres, but would require elevated approaches to the bridge extending 75m on the western side and 50m on the eastern side of the bridge. This will place abutments just clear of the top of the Bomaderry Creek Gorge, and allow room beneath the eastern abutment for fauna movement and retention of the existing footpath system operating there.

The Central Option would impact on the following services, which may need to be relocated:

- The Shoalhaven Water 600mm diameter trunk watermain that runs parallel to the Central Option, as well as water services to land users on the northern side of Narang Road.
- The Integral Energy 33kV transmission line that runs parallel to the Central Option.

The existing local electricity transmission lines are located on the eastern side of Illaroo Road, where it would connect with the Central Option. Relocation of existing power poles may be needed as part of the intersection works. Telecommunications infrastructure (Telstra and Optus) are located on the western side of Illaroo Road and so are unlikely to be impacted in this location. Telstra services are also located on the north side of Narang Road, and these will be further considered in the detailed design.

Further details of services infrastructure that will or may be impacted by the central Option is provided in **Appendix L**.

7.3.2 Central Option – Intersections

At the western end of this corridor, the existing intersection layout of Illaroo Rd and Pitt St consists of the following (as shown in **Figure 7.3**):

- 1 approach lane on Illaroo Rd (north leg);
- 2 approach lanes on Illaroo Rd (south leg) including a short left turn lane; and
- 2 approach lanes on Pitt Street (west leg) including a short left turn lane.

Construction of the Central Option would require the intersection to be upgraded to a single lane roundabout, as shown in **Figure 7.4**.

The existing intersection layout of the Princes Highway and Narang Rd consists of a non-mountable roundabout including the following (as shown in **Figure 7.5**):

- 2 through lanes on Princes Highway (both approaches);
- 2 approach lanes on Narang Rd west approach (left and through/right); and
- 1 approach lane with all movements on the West Birriley St east approach.

This roundabout layout remains unchanged throughout the future years and operates satisfactorily.

Figure 7-3: Illaroo Road and Pitt Street Existing Layout

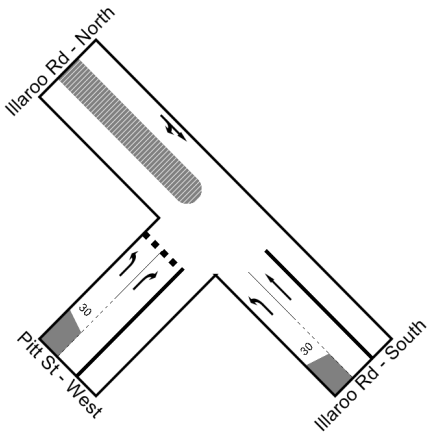
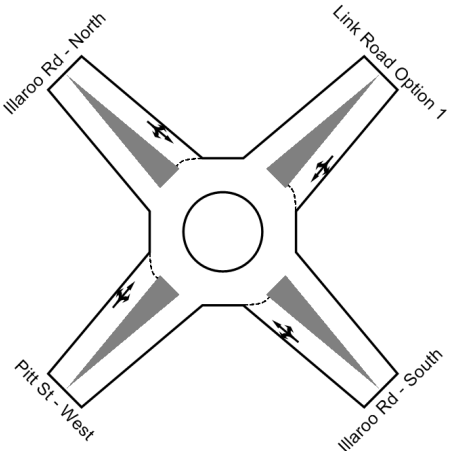
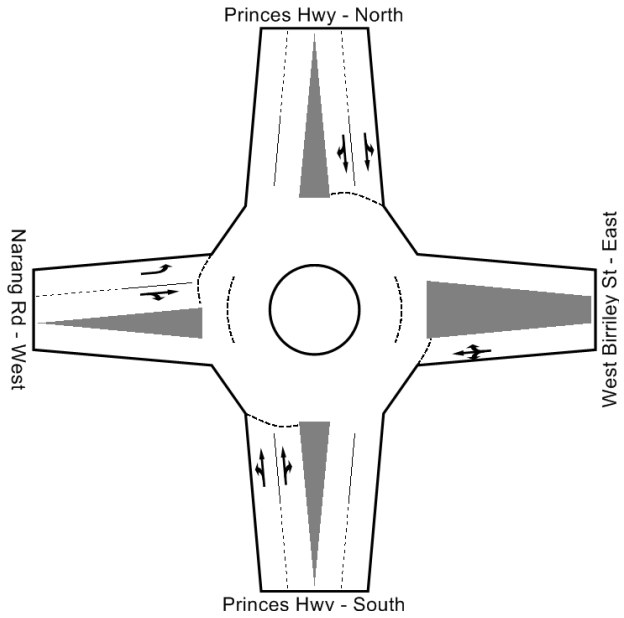


Figure 7-4: Illaroo Road and Pitt Street Required Layout for Option 1



Source: AECOM, 2010

Figure 7-5: Princes Highway and Narang Road Existing and Required Future Layout for Option 1



7.3.3 Central Option – Costs

The most recent estimated construction cost is $13.0 million. This includes allowances for underground power (in the vicinity of, and within the proposed bridge), vegetation clearing, a noise wall / berm at western end, and 40% for contingencies (it is common practice to apply contingencies in this order prior to the development of detailed designs).

7.4 Option 2: Southern Route Option

This Southern Route Option would link Illaroo Road and the Princes Highway at West Bunberra Street, crossing Bomaderry Creek further to the south east (of Option – Central Route) and generally following the southern boundary of the Bomaderry Creek Regional Park.

A new intersection on Illaroo Road would be located approximately 80m north of Falcon Crescent (measured along Illaroo Road) or approximately 55 m north of Falcon Crescent (if measured perpendicular to Falcon Crescent, and the eastern connection to the Princes Highway would be located at the existing intersection with West Bunberra Street.

7.4.1 Southern Option – Design and Bridge Parameters

The design speed for this corridor would also be 80 kph, reducing to the sign posted speed of the adjoining roads for an appropriate length to improve safety, currently 60kph at the west end (current sign posted speed on Illaroo Road), and 70kph at east end (current sign posted speed on Princes Highway) although a lower actual speed environment is likely at the eastern end due to the physical constraints that dictate the alignment of the road. The total route length would be approximately 1,820 metres.

Construction would likely require a three span concrete box girder bridge about 110 metres long to span the gorge at the point where the road would cross Bomaderry Creek, one of the deepest parts of the Bomaderry Creek Gorge.

The existing local electricity transmission lines are located on the eastern side of Illaroo Road, where it would connect with the Southern Option. Relocation of existing power poles may be needed as part of the intersection works. Telecommunications infrastructure (Telstra and Optus) are located on the western side of Illaroo Road and so are unlikely to be impacted in this location.

At its eastern end the Southern Route would impact the following services infrastructure:

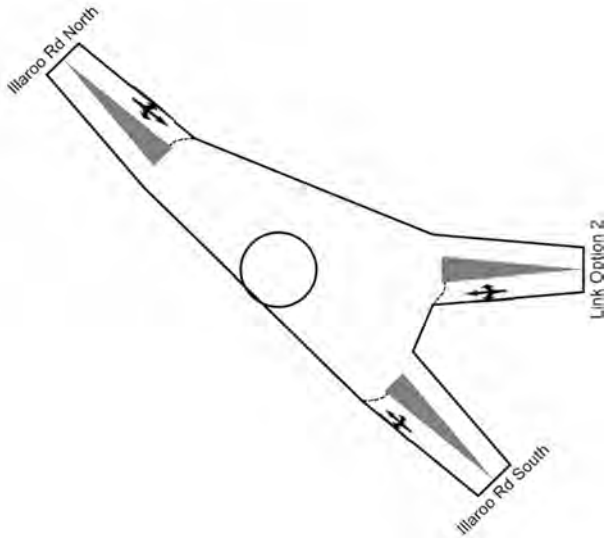
- A sewer main which services dwellings to the west of the Princes Highway. This sewer main may require treatment such as concrete encasement.
- Gas reticulation is underground in the footpath on the western side of the Princes Highway at the location where the Southern Option would intersect. Further investigation of the gas line would be required in regards to whether additional protection or relocation or would be required.

Further details of services infrastructure that will or may be impacted by the central Option is provided in **Appendix L**.

7.4.2 Southern Option – Intersections

There is no current intersection on Illaroo Road at the possible location of the Southern Option, between Byron Avenue and Falcon Crescent. If Option 2, the Southern Option, was constructed then a single lane roundabout intersection would be required at the new intersection, as shown in **Figure 7.6**.

Figure 7-6: Required Layout for Intersection of Illaroo Road with Option 2



A new connection to the Princes Highway would be required for the Southern Route Option, requiring demolition of the existing dwellings and an upgrade of the existing intersection between the Princes Highway and West Bunberra Street.

The existing intersection layout of the Princes Highway and West Bunberra St, as shown in **Figure 7.7**, consists of:

- Two through lanes and a right turn lane of 50m on the Princes Highway south leg.
- A marked left turn lane and a marked short right turn lane of 30m on West Bunberra St east.
- Two through lanes on the Princes Highway north leg.

Construction of the Southern Option would require this intersection to be reconstructed with traffic signals to be installed with the following layout:

- A shared through and left turn lane, a through lane and a right turn lane of 50m on the Princes Highway north and south legs. After 2016, it is likely that the right turn lane (south leg) will require extension.
- A shared through and left and a right turn lane of 30m on the West Bunberra St east approach.
- A shared through and left and a separate right turn lane on the Link Rd Option 2 west approach.

The required future intersection arrangement is shown in **Figure 7.8**.

Figure 7-7: Princes Highway and West Bunberra Street Existing Layout

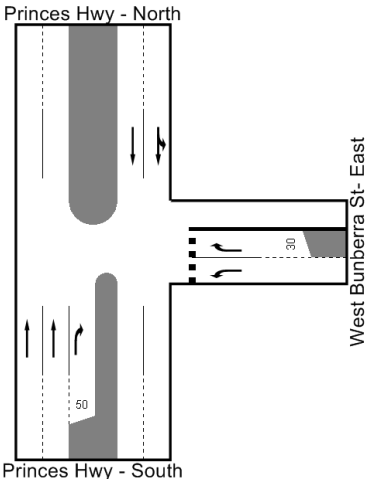
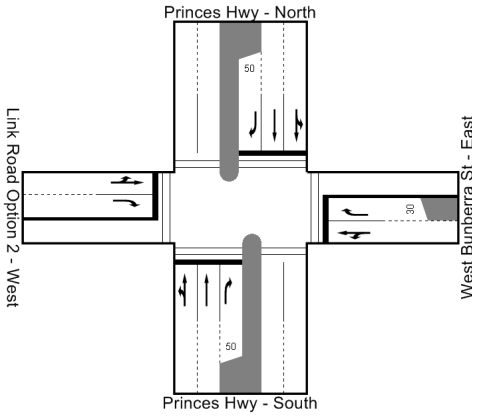


Figure 7-8: Princes Highway and West Bunberra Street Required Layout



7.4.3 Southern Option – Costs

The most recent capital cost estimate of this option is $18.5 million. This provides allowances for vegetation clearing and a noise berm at the western end, noise wall, acquisition of private property, and 40% for contingencies (it is common practice to apply contingencies in this order prior to the development of detailed designs).

7.5 Option 3: Northern Route Option

The Northern Route Option would link Illaroo Road and Moss Vale Road by generally following the alignment of West Cambewarra Road, running parallel to the south of West Cambewarra Road inside the northern boundary of the Bomaderry Creek Regional Park. The eastern connection to Moss Vale Road would be at the existing intersection of Moss Vale Road and Elvin Drive.

7.5.1 Northern Option – Design and Bridge Parameters

In determining the design requirements and proposed alignment for the Northern Route Option there are two key considerations.

- The proposed road is to be a sub-arterial road which by standards does not permit private accesses. As such, it would not be possible to construct the link road within the existing road reserve for West Cambewarra Road or as a widening of the existing West Cambewarra Road, but a new road is required. Importantly, to address safety and amenity concerns the existing West Cambewarra Road would need to be retained for access by residents only.

A single connection point, approximately midway along West Cambewarra Road, would be proposed to provide access for the residents of West Cambewarra Road onto and off the Northern Route Option.

- The close proximity of residential dwellings on West Cambewarra Road will mean that it would be necessary to set back the Northern Route Option significantly from the residences and/or to provide significant noise attenuation measure, such as an earth bund or noise wall. The noise mitigation (e.g. earth bund or noise wall) would not work if it was interspersed by numerous private accesses creating gaps in the mitigating structure, supporting the proposed single central access point connecting the Northern Route Option with West Cambewarra Road.

  An initial proposed set back of approximately 50 m has been provided for, however this would be dependent on the final noise mitigation treatment selected through detailed design and after detailed noise modelling. Note the proposed 50m setback has not been designed only to address noise impacts, but includes the Northern Options road reserve and represents the absolute minimum allowable distance for the connection to West Cambewarra Road. It is expected that a suitable vegetated noise mounding treatment would be possible between the Northern Option and West Cambewarra Road within the proposed setback.

The overall road length would be approximately 1,730 metres. The design speed for this corridor would also be 80kph, reducing to the sign posted speed of the adjoining roads for an appropriate length to improve safety, currently 60kph at west end (current sign posted speed on Illaroo Road), and also 60kph at east end (current sign posted speed on Moss Vale Road at Elvin Drive) although a lower actual speed environment is likely at the eastern end due to the physical constraints that dictate the alignment of the road.

Where Option 3 crosses Bomaderry Creek the valley is a broader shape (compared with the gorge profile at the Central and Southern Options) with a relief of about 5m at the creek. Assuming an economical abutment height of about two metres, the bridge at this crossing would still need to be approximately 75m, which will also locate the abutments at about the 1% flood level.

The level of the bridge required at the northern Bomaderry Creek crossing is another reason for the necessary displacement of the northern route from (to the south of) the existing West Cambewarra Road, to mitigate the adverse impacts on adjacent property access at the far eastern end of West Cambewarra Road which would otherwise be directly impacted by the elevated road construction and associated embankments required to form the western approach to the bridge.

At its western end, the Northern Option would affect the existing local electricity transmission lines where it would connect with the Illaroo Road/Cambewarra Road intersection. Telecommunications infrastructure (Telstra and Optus) are located on the western side of Illaroo Road and so are unlikely to be impacted in this location. Reticulation of water in this area is complex and would require attention in design and construction of the link road.

At its eastern end, Optus has optic fibre cabling infrastructure servicing the saleyards, which would be considered during the design and construction of the road.

Further details of services infrastructure that will or may be impacted by the central Option is provided in **Appendix L**.

7.5.2 Northern Option – Intersections

The existing intersection layout of Illaroo Rd and West Cambewarra Rd, as shown in **Figure 7.9**, consists of:

- Single lane approach on Illaroo Rd south-east leg;
- Single lane approach on Illaroo Rd north-west leg; and
- Single lane approach on West Cambewarra Rd east leg.

If the Northern Option was constructed then a new single lane roundabout at the intersection with Illaroo Road would be required, as shown in **Figure 7.10**.

Figure 7-9: Illaroo Road and West Cambewarra Road Existing Layout

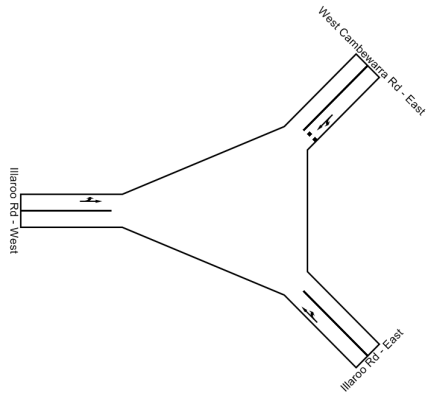
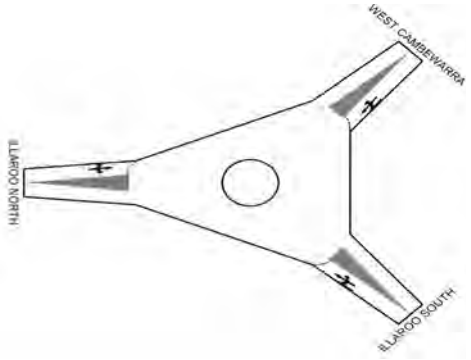
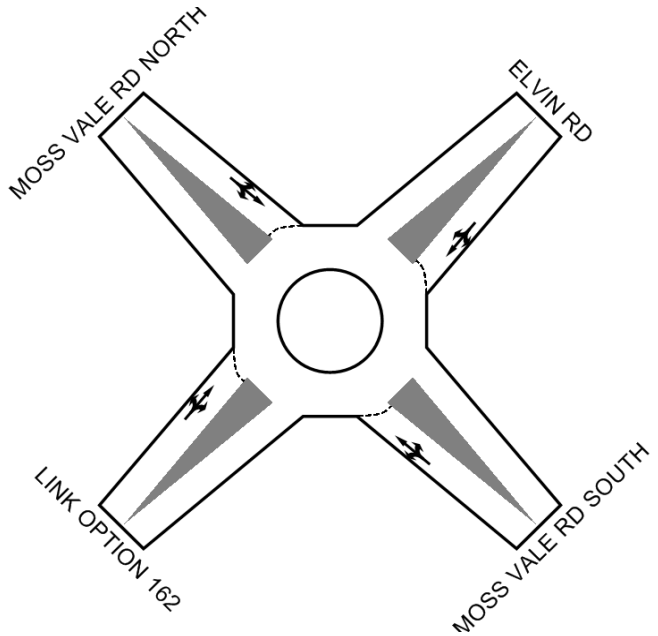


Figure 7-10: Illaroo Road and West Cambewarra Road Required Layout



The new intersection that would be required with Moss Vale Road would be a single lane roundabout layout, as shown in **Figure 7.11**.

Figure 7-11: Moss Vale Road and Northern Option Required Layout



7.5.3 Northern Option – Costs

The most recent capital cost estimate for this option is $14.3 million. This provides allowances for vegetation clearing and a noise berm along West Cambewarra Road, costs associated with the local access connection to West Cambewarra Road, and 40% for contingencies (it is common practice to apply contingencies in this order prior to the development of detailed designs).

7.6 Summary of Key Parameters of Route Options

A summary of the key design parameters for each of the 3 route options is provided in **Table 7.1**.

Table 7-1: Summary of Key Parameters of Route Options

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Total Length	1810 m	1820 m	1730
Length of Bridge	75 m	105 m	75 m
Cost	$13 M	$18.5M	$14.3

PART C
Statutory Requirements and Environmental Assessment

8.0 Planning and Approvals

8.1 Statutory Planning Context

8.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) governs the approvals process for developments in the State. In August 2005, the Act was amended with a new Part 3A which deals with the approval of Major Projects. Section 75B(1) of the Act notes that Part 3A applies to development declared under a State Environmental Planning Policy or by order of the Minister for Planning.

On 5 December 2006 the Minister published an order in the NSW Government Gazette No. 186 declaring that the North Nowra Link Road project was covered by Part 3A of the EP&A Act. A copy of the Gazetted order is reproduced in **Appendix A**.

8.1.2 State Environmental Planning Policy (Infrastructure) 2007

Clause 94 of *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP) provides that development for the purposes of a road may be carried out by a or on behalf of a public authority on any land without development consent except where the land is reserved under the *National Parks and Wildlife Act 1974* (NPW Act).

The project will affect land within the Bomaderry Creek Regional Park which is land that has been dedicated under the NPW Act. For land that is reserved under the NPW Act, one of three things must be in effect for the project to proceed, either

- authorisation under the NPW Act is required, or
- the road must be identified as an existing interest within the meaning of section 39 of NPW Act, or
- the land subject to the NPW Act must have an easement applying and the project must not be contrary to the terms or nature of the easement.

Authorisation under the NPW Act will be required for the project to proceed since it is not covered by an easement nor does it have an existing interest in the Regional Park.

8.1.3 Illawarra Regional Environmental Plan No. 1

Illawarra Regional Environmental Plan No. 1 gazetted in 1986 recognised the sub regional centre role of Nowra Bomaderry.

Many provisions of the *Illawarra Regional Environmental Plan No. 1* have been repealed and it is not considered that any remaining provisions would apply to the project.

8.1.4 Shoalhaven Local Environmental Plan 1985

The *Shoalhaven Local Environmental Plan 1985* (SLEP) provides for permissibility and development controls for all land within the Shoalhaven Local Government Area, by establishing a land use zone for each piece of land.

Land subject to the following zones would be potentially impacted on by the proposed North Nowra Link Road:

- 2(a1) Zone – Residential A1 Zone.
- 2(c) Zone – Residential C (Living Area) Zone
- 2(d) Zone – Residential D Zone
- 3(b) Zone – Business "B" (Transitional) Zone
- 6(a) Zone – Open Space – Recreation "A" (Existing) Zone
- 6(c) Zone – Open Space – Recreation "C" (Proposed) Zone

Zones of the land within the study area and surrounding the study are is shown in **Figure 6.3**. Development for the purposes of a road is permissible with development consent in all of these zones.

8.1.5 Statutory Planning Approvals Process

Section 75F sets out the environmental assessment requirements for approval under the EP&A Act.

Council sought the Director General's requirements on the form and content of the environmental assessment from the Department of Planning. The Director General's requirements for the Environmental Assessment, dated 3 May 2009 are included in **Appendix A**.

This Environmental Assessment report will be reviewed by the Department of Planning and if found adequate, will be publicly exhibited for a minimum of 30 days. During that time, submissions will be invited from public authorities, interest groups and members of the local community who wish to input their views on the project.

8.2 Other Approvals and Licences

8.2.1 Legislation that Does Not Apply

- *Coastal Protection Act 1979*
- *Fisheries Management Act 1994*
- *Heritage Act 1977*
- *Rivers and Foreshores Improvement Act 1948*
- *Rural Fires Act 1997*

8.2.2 Statutory Approvals That Do Not Apply

There are several pieces of legislation that normally apply to development of a road in the proposed location. However, Section 75U of the EP&A Act specifies legislative approvals are not required in regards to a project approved under Part 3A of the EP&A Act. In particular, the following approvals that would have been likely to be required for the North Nowra Link Road would not be required if the project is approved under Part 3A of the EP&A Act:

- a permit under section 87 or a consent under section 90 of the *National Parks and Wildlife Act 1974* (NPW Act) to affect or destroy an Aboriginal object
- an authorisation referred to in section 12 of the *Native Vegetation Act 2003* to clear native vegetation or State protected land,
- an activity approval under section 91 of the *Water Management Act 2000.*

In addition, under Section 91AA(4) of the NPW Act a stop work order cannot be issued by the Director-General for any action that is essential for the carrying out of an approved Part 3A Project.

8.2.3 Threatened Species Conservation Act 1995

Several threatened plant and animal species found in the Bomaderry Creek area are listed on the schedules of the Threatened Species Conservation Act 1995 (TSC Act).

The following species are listed under the TSC Act and are known to occur within the Bomaderry Creek area, or contain habitat within the Bomaderry Creek area;

- Bomaderry Zieria - *Zieria baeuerlenii* is listed as an endangered species under Schedule 1 of the TSC Act and at present is only known to exist in the Bomaderry Creek area.
- *Eucalyptus langleyi* (common name Albatross Mallee), listed as Vulnerable under the NSW TSC Act, and is known to occur within the study area. The NSW Scientific Committee made a Preliminary Determination to list the Bomaderry population of *Eucalyptus langleyi* as an endangered population on 11 June 2010.
- *Genplesium bauera* (common name Bauer's Midge Orchid), listed as Vulnerable under the NSW TSC Act, and is known to occur within the study area.
- *Hibbertia sp. Nov. 'Menai'* listed Endangered under the NSW TSC Act, is known to occur within the study area.
- Giant Burrowing Frog which is listed as vulnerable under the NSW TSC Act, and contains potential habitat within the study area.

The project may require:

(a) the picking of a plant that is of, or is part of, a threatened species, population or ecological community,

(b) damage to habitat of a threatened species, population or ecological community.

Under Section 91 of the TSC Act a licence from the Director-General of DECCW will be required prior to being able to carry out these activities.

In deciding whether to grant a licence for the above, the Director-General is required to determine whether the actions are likely to result in significant impact to the threatened species, population or ecological community.

In addition, under Part 3 of the TSC Act the Minister for the Environment can declare habitat to be Critical Habitat. In 2002, the National Parks & Wildlife Service prepared a Critical Habitat Identification Report that recommended identification of the Critical Habitat for the Bomaderry Zieria. This recommendation has not been adopted by the NSW Government, and so the habitat is not currently declared to be Critical Habitat. If there is predicted to be significant impact or the land to be affected is declared to be Critical Habitat then there is a requirement for the preparation of a Species Impact Statement (SIS).

In relation to these two tests:

- An assessment of significance of the impacts of the project to the species listed under the TSC Act has been carried out, concluding that the project is not expected to result in any significant impacts to threatened species, populations or ecological communities.

- Notwithstanding the Critical Habitat Identification Report, and recommendation from NPWS of 2002, the impacted vegetation has not been declared by the Minister to be Critical Habitat.

Notwithstanding the above, Part 3A of the EP&A Act requires that a biodiversity assessment be carried out in accordance with the Director-General's Requirements.

8.2.4 The Protection of the Environment Operations Act 1997

The proposed North Nowra Link Road will be a single lane of traffic in each direction. As such, it does not meet the threshold established in Clause 35 of Schedule 1 of the *Protection of the Environment Operations Act 1997*, and it is therefore not a scheduled activity.

8.3 Commonwealth EPBC Act

Three species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are potentially affected by the North Nowra Link Road.

- *Eucalyptus langleyi*
- *Zierria baeuerlenii*
- *Giant Burrowing Frog*

Accordingly, a referral has been made to the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA). DEWHA has determined that the project constitutes *and controlled action*. As such the project will require assessment and approval under the EPBC Act before it can proceed.

DEWHA has accredited the assessment process established under Part 3A of the EP&A Act, and will therefore assess the project concurrently with the NSW Department of Planning. Notwithstanding this, the Commonwealth is not bound by any decision made by the NSW Minister for Planning, but will independently consider and determine the project with consideration of matters of national environmental significance. The Commonwealth may make a different decision to the NSW Minister for Planning or may impose additional conditions on any approval.

8.4 Revocation of Land Within a Regional Park

The project will affect land within the Bomaderry Creek Regional Park, which has been dedicated under the NPW Act, so requiring revocation of that land from the Regional Park to proceed.

Revocation of land dedicated as Regional Park can sometimes take place for a public road where no practical options are available. Revocation of land from within a Regional Park can only be undertaken once the Minister for the Environment has carried a Bill through Parliament which revokes the specified land.

The administrative processes for revocation of land from within a Regional Park are outlined in the NSW Government's Revocation of Land Policy (NPWS, 2002). Under the policy, a proponent must provide details of a proposal to the Director General and the Minister for the Environment and demonstrate that revocation is essential and that the public value of the proposal outweighs any conservation loss. A detailed assessment of the matters for consideration is provided for the preferred route in Section 21 of this EA Report.

9.0 Consultation

9.1 Background

Community consultation on the link road commenced in 1974 with the release of the first Nowra Bomaderry Structure Plan. This identified the potential for a traffic bottleneck at the Illaroo Road and Princes Highway intersection.

The 1986 Shoalhaven LEP was publicly exhibited showing a proposed route extending Narang Road to Bomaderry Creek. There was extensive public consultation in preparation of the 1992 Development Application for the link road. Council considers that community support was strongly in favour of the project from the majority of North Nowra residents.

Further consultation occurred with public meetings and focus workshops in 1995 finding strong community support for a link road, although a low number of conservation interests continued to oppose the route.

Community consultation occurred in preparation of the Nowra Bomaderry Structure Plan including newsletters, public exhibition and a public meeting on the 22 March 2006. Over 215 submissions were received between the 1st March and the 19th May 2006 in relation to the Structure Plan, including 20 from Government agencies. Of those, 23 referred to the North Nowra Link Road with 22 indicating their opposition to a route through the Regional Park.

9.2 NSW Government Authorities

A planning focus meeting was held for the North Nowra Link Road on 13 March 2007. Representatives from the following agencies were in attendance:

- Department of Planning,
- National Parks & Wildlife Service,
- Department of Primary Industries [Fisheries],
- Roads and Traffic Authority and
- Department of Natural Resources.

The purpose of the planning focus meeting was to allow Council to outline the scope of the assignment and to obtain feedback from all the agencies present on what key issues should be addressed in the environmental assessment.

Following on the planning focus meeting, the Department of Planning sought environmental assessment requirements from the agencies to assist Council in carrying out the environmental assessment for the project.

Based on the comments at the meeting and subsequent correspondence from the relevant agencies the Department of Planning prepared the Director-General's Requirements for the environmental assessment, which were sent to Council dated 16 April 2007, and subsequently lapsed on 16 April 2009.

A revised set of Director-General's Requirements were issued by the Department of Planning on 3 May 2009. This Environmental Assessment Report (EAR) is required under the provisions of the EP&A Act to comply with the Director-General's Requirements (DGRs) that were issued for the project.

In preparing the DGRs, the Department of Planning received formal correspondence from the following agencies:

- Roads and Traffic Authority
- Department of Environment and Conservation
- Department of Natural Resources
- Department of Primary Industries

9.2.1 Issues Raised by Agencies

Roads and Traffic Authority

The Roads and Traffic Authority (RTA) generally support the outcomes of the AECOM traffic modelling, including the recommendation of the Central Route Option, due to its strategic fit with the existing road infrastructure. The RTA have also been asked to comment on the adequacy of the traffic modelling and assessment which has been carried out for the project.

The RTA's response stated:

> *"A meaningful data update of the model would not be possible until after the publication of 2011 census data. Attempting to update the model prior to 2011 census would not necessarily provide a 'better' model as many of the assumptions on the base data would still be necessary.*
>
> *The alternative to an update would be to disregard the existing model and rebuild a new model from the base up. This would be a long and expensive exercise and would appear hard to justify for what would only result in a relatively minor improvement to the modelling that we currently have available to us."*

The RTA recommends retaining the current model until at least after 2011 census data is available, at which time, if deemed necessary it may be worth updating the model.

Department of Environment and Conservation

The Department of Environment, Climate Change and Water (DECCW) specified a wide range of requirements. These requirements are listed in **Table 9.1** below, with a description of how the issue has been addressed in the EAR and where further discussion can be found in the EAR.

Table 9-1: Summary of DECCW Assessment Requirements and where they have been addressed

DECCW Assessment Requirement	How Addressed and EAR Cross Reference
A description of measures that will be implemented to ensure no pollution of waters.	Water quality mitigation and management is provided in **Section 17**.
Documentation of the assessment and management of any contaminated land.	Consideration of contaminated land assessment and management is provided in **Section 17.5**.
That the road be designed, constructed, operated and maintained so that there is no adverse impacts from noise.	Noise impact assessment is provided in **Section 14** and as part of **Appendix E**.
Assessment of threatened species and their habitats.	Biodiversity impacts have been assessed in **Section 13** and **Appendix F**.

DECCW Assessment Requirement	How Addressed and EAR Cross Reference
Asses the impact on the conservation value of the bushland.	Biodiversity impacts have been assessed in **Section 13** and **Appendix F**.
Assess the nature and extent of impacts on Aboriginal cultural heritage values, and describe the outcomes of consultation with Aboriginal communities.	Impacts to Aboriginal heritage are assessed in **Section 16** and **Appendix G**. Consultation with the Aboriginal community is also discussed in **Section 9.4**.
Assess the revocation of land from the Bomaderry Creek Regional Park for the project against the NSW Government's *Revocation of Land Policy*.	Revocation of land from the Regional Park has been assessed in **Section 21**.

Consultation with DECCW has continued throughout the preparation of the Concept Plan EAR. This has included meetings with DECCW representatives dated 30 March 2010, 27 April 2010 and 10 June 2010. DECCW has provided feedback in regards to scope of the technical assessment to be carried out for the project.

Department of Primary Industries

The Department of Primary Industries (DPI) requests that the environmental assessment:

- Describe aquatic environments and riparian habitats
- Assess impacts to these environments and habitats as well as to water quality and aquatic threatened species.
- Provide mitigation for predicted impacts on these environments and habitats.
- Confirms that the proposed development is consistent with the South Coast Regional Strategy in relation to the protection of riparian zones and best practice water quality management.

The DPI advises further that:

- The proposed development, including the bridge, must be designed and constructed to minimise habitat loss, changes in transport and stream siltation and to maintain natural tidal exchange and river flow.
- Appropriate sediment and erosion control and water quality management provisions must be designed in accordance with best management practices.
- Monitoring of water quality downstream in Bomaderry Creek should take place during and after construction.

An assessment of biodiversity impacts is provided in Section 13 and **Appendix F**, and consideration of water quality issues, including flooding and riparian habitat, and water quality management measures to be applied during construction, is provided in Section 17. The design parameters for the proposed bridges are provided in Section 7.2 and **Appendix D**.

Department of Natural Resources

The Department of Natural Resources (DNR) identifies that the Central Route Option is considered to be inconsistent with the NSW Government Natural Resource Management policy directions, the NRC targets, the Department of Planning's biodiversity outcomes outlines in the South Coast Regional Strategy and the Southern Rivers Catchment Management Authority's Catchment Action Plan targets.

As such, the DNR states a preference for the Northern Route Option to be progressed as the preferred route since it is considered to be more in alignment with the State's natural resource direction.

Secondly the DNR identifies that the Bomaderry Creek is classified as a Category 1 – Environmental Corridor. The overarching objective of this Category is to provide biodiversity linkages by maintaining connectivity for the movement of aquatic and terrestrial species along the riparian corridor and between key destinations. DNR identify that a Category 1 management outcome would require a fully piered/bridge crossing of Bomaderry Creek and the adjoining core riparian zone (i.e. 40 m wide on both sides of the creek). In addition, structures such as water quality control ponds and other associated infrastructure should be located outside of the core riparian zone.

Finally, the DNR recommends that the absolute footprint of each route option be assessed.

Section 2 of this EAR sets considers the North Nowra Link Road in the context of the State Plan and the South Coast Regional Strategy and it is not considered that the project is inconsistent with these plans and strategies.

An assessment of biodiversity impacts is provided in Section 13 and **Appendix F**, and consideration of riparian issues, including flooding and riparian habitat, and water quality management measures to be applied during construction, is provided in Section 17. The design parameters for the proposed bridges are provided in Section 7.2 and **Appendix D**.

The environmental assessment for the Concept Plan has assessed the absolute corridor of each route option, based on the current level of design. Where necessary mitigation measures have been proposed that limit the width of the corridor so as to ensure potential environmental impacts are avoided or minimised.

Rural Fire Service

The Rural Fire Service has reaffirmed the importance of improved access to North Nowra, Bangalee and Tapitallee. It also sees the importance of a North Nowra Link Road providing access to back-up resources from Berry entering the area from the Princes Highway. A new Link Road would afford better vehicular entry and escape routes in times of emergency incidents such as traffic accidents and fires as well as for hazard reduction operations.

The NSW Rural Fire Service indicates that its preferred option is the Central Route as it would increase the accessibility to the bushland areas and aid significantly in the control and suppression of bushfires.

9.3 Neighbours, Landowners and Organisations

9.3.1 2001 Community Consultation

In 2001 the consultants Brown and Root were engaged to review and update the options study due to changes to infrastructure impact assessment procedures that had occurred since 1995. A newsletter was distributed to 2,400 residences in North Nowra and 2,500 residences in Bomaderry. A community newsletter showing multiple route options was issued. A community workshop was held on 15 October 2001 to review the options and determine community values.
The public workshop was attended by approximately 100 people. It included four working groups focusing on the need for a link road, possible route options, evaluation criteria and their importance.

Brown and Root reported – "It was clear there were divided opinions from workshop attendees about the route options and the primary functions of the proposed road. There was significant support for the West Cambewarra Road route and adjoining options as well as for the Pitt Street to Narang Road option. There was also significant opposition to these options. There were differing opinions on the role and function of the proposed link road including providing for North Nowra – Bomaderry connections, alternative access to the town centre, future urban expansion of Nowra and the proposed Western Bypass Corridor as an alternative river crossing."

This feedback prompted Council to defer further action until the Nowra Bomaderry Structure Plan was advanced to conceptual form.

9.3.2 2006/2007 Community Consultation

Community consultation was undertaken by Mr M Brown MP, Member for Kiama in the lead up to the 2007 NSW Government election. In early 2006 approximately 2,600 letters were issued to households on the electoral roll in North Nowra, Bangalee, Tapitallee, together with a return mailer, questionnaire and a park and route map. The questionnaire sought a response to three statements:

- I support the construction of a Link Road that crosses the Regional Park and the addition of 51ha of quality bushland to the Regional Park Central Route (Option 1)
- I support whatever the majority view is on the road proposal
- I do not support the Council's preferred route Central Route (Option 1)

The response was as follows:

- Support for Link Road 489 households (868 people)
- Opposition to the Link Road 84 households (141 people)

9.3.3 2007 Community Consultation

In early 2007 Council prepared "Information Flyers" on the three options and distributed them to the media and persons enquiring about the project. The flyers outlined the results of traffic modelling and the economic analysis.

9.3.4 2007 Community Survey

GHD were commissioned to consult the community about the project via a letter box drop in September 2007. The preferences of the 3 short-listed route options were canvassed. Four hundred and fifty letters were distributed to residences within 200m of the three route options. A letter, map, feedback form and a reply paid envelope were included.

113 responses were received, giving a response rate of 25%. These showed:

- 63 responses were in favour of Option 1 (Central Route) (i.e. 56% of responses);
- 17 responses were in favour of Option 2 (Southern Route) (15.8% of responses);
- 30 responses were in favour of Option 3 (Northern Route) (26.5% of responses);
- 1 response opposed any option; and
- 2 responses urged the construction of any option.

The survey forms included the opportunity for members of the community to provide qualitative feedback in relation to the project in general or in relation to any of the 3 specified route options. The local community identified the following issues and comments in relation to the three route options.

Table 9-2: Summary of Key Community Issues Identified on Feedback Forms

Central Route Option	Northern Route Option	Southern Route Option
Community Identified Issues and Comments of Each Route Option		
▪ It is the most direct route; ▪ There is already an existing disturbed track along the route, so impacts on vegetation would be the least; ▪ Safest access onto the Princes Highway; ▪ Less interference with residents' privacy; ▪ Most logical and cost effective; ▪ Least impact on residents from traffic noise; ▪ Remote from West Bunberra Street Anglican School and the ambulance station; ▪ Best access to Regional Park; and ▪ Makes use of existing roundabout.	▪ No one would use northern route. ▪ West Cambewarra Road is already there; ▪ Cambewarra Road was historically the link road; ▪ Leaves park intact; ▪ Keeps congestion away from school and TAFE college; ▪ Less likely to be a drag racing route; ▪ Best access to sporting facilities; ▪ Least cost.	▪ This route provides the greatest traffic relief; ▪ Least danger to flora and fauna; ▪ Less impact on park; ▪ Less impact on pedestrian movements;

9.4 Consultation with the Aboriginal Community

Council advertised for Aboriginal stakeholders following the DECCW Interim Community Consultation Requirements for Applicants (DEC 2004, DEC 2005). The Nowra Local Aboriginal Land Council has already expressed an interest in the project during previous discussions and correspondence with Council.

In accordance with the Guidelines invitations for input were also sent to the following organisations:

- Jerrinja Local Aboriginal Land Council
- Jerrinja Consultants P/L
- South East Coast Gadu Elders Aboriginal Corp.
- Merrimans Local Aboriginal Land Council
- Ulladulla Local Aboriginal Land Council
- South Coast Aboriginal & Elders & Friends Group
- Yuin Traditional Owners

No Aboriginal stakeholders responded to the advertisement.

Adell Hyslop, Chief Executive Officer of the Nowra Local Aboriginal Land Council (NLALC), was contacted by phone to discuss the scope of the project and to arrange a date for an on-site meeting with a representative of the NLALC.

An on-site meeting was conducted on Tuesday, 1st December 2009, with Jason Davison, representative of the NLALC. The meeting consisted of a discussion of the three proposed road alignment options in relation to identified Aboriginal heritage values. An inspection of the area was undertaken as part of the consultation process.

Jason noted that the Central Option was his preferred road alignment option, based on the existing disturbance in the area. The existing disturbance included a weir across Bomaderry Creek, a transmission line easement and a large underground water pipeline.

The Southern Option was his least preferred option, based on the relatively undisturbed nature of the Bomaderry Creek gorge in that area.

The formal consultation process is described in more detail in Appendix G, and has included:

- advertising for registered stakeholders in local and Indigenous media;
- notification of closing date for registration;
- site inspections;
- on site meeting to discuss the archaeological and Aboriginal cultural heritage assessments and potential impacts;
- ongoing consultation with the local Aboriginal community; and
- ongoing compilation of Aboriginal registrants list, through continuing to register individuals and groups for consultation on the project.

9.5 Consultation with the Federal Government

Two threatened flora listed on the EPBC Act have been recorded within the study area during the field surveys, particularly in relation to the Central Option:

- *Eucalyptus langleyi* (Albatross Mallee) – Vulnerable.
- *Zieria baeuerlenii* (Bomaderry Zieria) – Endangered.

Fauna listed under the EPBC Act, being the Giant Burrowing Frog, the Grey-headed Flying-fox and Spotted-tail Quoll are also thought to exist within the Regional Park or contain habitat that might be suitable within the Regional Park.

As such, Council made a referral to the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) in November 2009 for the Central Option for the proposed North Nowra Link Road.

The Acting Assistant Secretary determined on the 10 January 2010 that development for the purpose of the NNLR Central Option was a controlled action under the EPBC Act and would therefore require the approval of the Commonwealth to proceed.

Further consultation has taken place with representatives from DEWHA to ensure biodiversity impacts have been assessed in accordance with DEWHA's requirements. This included a joint site inspection with DEWHA officers and Council on 28 April 2010 as well as DEWHA representatives attending a meeting between Council, the Department of Planning and DECCW on 10 June 2010.

The Acting Assistant Secretary's determination identified that the project will be assessed by accredited assessment under Part 3A of the EP&A Act.

10.0 Director General's Environmental Assessment Requirements

On 3 May 2009, in accordance with Section 75F of the EP&A Act, the Director-General of the Department of Planning issued the requirements for the preparation of an Environmental Assessment to accompany a Concept Plan for the project. A copy of the DGRs is included in **Appendix A**.

Table 10.1 provides a detailed summary of the individual matters listed in the DGRs and identifies where each of these requirements has been addressed in this report and the accompanying technical studies.

Table 10-1: Summary of Where the Director-General's Requirements are addressed in the EAR

DG Requirement	Where found in the EA	What has been provided
General Requirements		
EA to include an Executive Summary	Executive Summary	Executive Summary
A description of the proposal is to be provided including alignment and corridor width	Section 7 Appendix C Appendix D	A detailed description of the route alignments for the 3 options is provided; including the proposed route option corridor, an indicative road alignment within the corridor, the required intersection upgrades and road and bridge design parameters.
An assessment of the environmental impacts of the proposal is to be provided with particular focus on the key assessment requirements specified below	Section 11 to Section 19	Environmental impact assessment for each of the key assessment is provided as described in the 'specific requirements' section below.
Justification for undertaking the proposal with consideration of the benefits and impacts	Section 23	A summary of the projects benefits and impacts is provided.
A draft Statement of Commitments	Section 22 Appendix K	A draft Statement of Commitments is provided for each route option.
Certification by the author that the information is neither false nor misleading	Inside of the Cover Page	
Specific requirements		
Strategic Justification for the 3 route options	Section 2 Section 11 Section 23	Section 2 provides a detailed analysis of the Strategic Context of North Nowra and demonstrates the consistency of the NNLR with State-wide strategies and plans as well as the importance of the NNLR in the context of local strategic plans for Nowra Bomaderry. Section 11 assesses the strategic issues including impacts on surrounding land uses, including the amenity of land users within the Bomaderry Creek Regional Park Section 23 summarises the overall project justification with consideration of benefits and impacts.

DG Requirement	Where found in the EA	What has been provided
Biodiversity	Section 13 Appendix F	A detailed assessment of potential impacts to threatened fauna and flora, has been provided.
Road and Traffic	Section 12 Appendix E	Detailed traffic modelling has been carried out to determine the overall network benefits of each route option, and the comparative effectiveness of each option.
Noise Impacts	Section 14 Appendix E	A semi-quantitative analysis of the likely compliance with the NSW DECCW's ECRTN has been carried out to identify the ability of each option to comply with the ECRTN. Likely mitigation measures have been identified.
Urban Design	Section 15 Appendix H	An assessment of the visual impact of each route option has been carried out.
Aboriginal Heritage	Section 16 Appendix G	An assessment of the potential impact on Aboriginal heritage archaeology and areas of cultural significance has been carried out.
Soil and Water	Section 17	An assessment of the potential impacts associated with each of the route options has been provided, including description of the mitigation and management measures that would be considered during detailed design.
Socio-Economic	Section 18 Appendix E	A detailed economic analysis for the 3 route options has been provided. Consideration of other social issues is provided.
General Environmental Risk Analysis	Section 19	An environmental risk analysis has been carried out for each of the 3 route options.

The following sections of the EAR assess and respond to the environmental impacts of the Concept Plan proposal. They address the matters for consideration set out in the DGRs as described above.

The draft Statement of Commitments (see Section 22 and **Appendix K**) complements the findings of the following environmental impact assessment sections.

11.0 Strategic Justification

Section 2 of this EA Report sets out in detail the strategic context of the proposed North Nowra Link Road. The following sections demonstrate the consistency of the project with the relevant priorities and objectives of the NSW State Plan and the South Coast Regional Strategy. The State-wide development and transport objectives have been further reflected in the Nowra Bomaderry Structure Plan. This Section also includes consideration of the local strategic planning issues including local amenity, impact to private property and sensitive land uses.

11.1 NSW State Plan

Table 11.1 demonstrates the consistency of the project with the relevant priorities and objectives of the NSW State Plan.

Table 11-1: Consideration of the NNLR Against the Priorities of the NSW State Plan

NSW State Plan Priority and Target	Consideration
Improve the road network with a target to "improve the efficiency of the road network during peak times as measured by travel speeds and volumes on Sydney's road corridors." Improve road safety with a target to "reduce fatalities to 4.9 per 100,000 population by 2016".	It is the stated objective of the project to improve the efficiency of the road network around North Nowra and Bomaderry, with particular emphasis placed on peak times, and to improve safety on this part of the local road network. While not in Sydney, the intent of the State Plan priority is considered relevant in the Nowra Bomaderry regional context.
Grow cities and centres as functional and attractive places to live, work and visit".	The proposed North Nowra Link Road is consistent with this State Plan priority as one of the aims of the project is to improve accessibility and amenity for local residents and to provide for the growth of North Nowra (see Section 2.3 for a detailed analysis of the project in the context of the endorsed Nowra Bomaderry Structure Plan).
Improve housing affordability", with a target to "provide at least 300,000 new dwellings in regional areas over the next 25 years, with an increased rate of infill development.	The proposed North Nowra Link Road is consistent with this State Plan priority as one of the aims of the project is to provide the transport infrastructure required for the growth of North Nowra living areas (see Section 2.3 for a detailed analysis of the project in the context of the endorsed Nowra Bomaderry Structure Plan which identifies infill housing development in North Nowra as well as new living areas).
Protect our native vegetation, biodiversity, land, rivers and coastal waterways", with a target to "meet our State–wide targets for natural resource management to improve biodiversity and native vegetation, sensitive riverine and coastal ecosystems, soil condition and socio–economic wellbeing.	The relevant State-wide natural resource management target is that there is an increase in the recovery of threatened species, populations and ecological communities. The proposed North Nowra Link Road is not inconsistent with this State Plan priority as detailed assessment has been carried out to ensure there are no significant impacts to threatened species, populations and ecological communities. Section 13 of this EAR details the biodiversity assessments that have been carried out.

11.2 South Coast Regional Strategy

The proposed North Nowra Link Road is consistent with this South Coast Regional Strategy as one of the aims of the project is to provide for the growth of North Nowra (see Section 2.3 for a detailed analysis of the project in the context of the endorsed Nowra Bomaderry Structure Plan). This is consistent with the stated objective of the Strategy for Nowra Bomaderry to be a major residential, employment and administrative area for the northern part of the South Coast Region

The proposed North Nowra Link Road is not inconsistent with the Regional Strategy's Biodiversity Outcomes. Detailed assessment has been carried out to ensure there are no significant impacts to biodiversity (Section 13 of this EAR details the biodiversity assessments that have been carried out). It is also highlighted that the proposed NNLR will provide infrastructure to cater for increased housing density within the existing living area of North Nowra, consistent with the Biodiversity Outcome to direct urban development away from conservation areas.

11.3 Nowra Bomaderry Structure Plan

The NBSP concludes that the North Nowra Link road will provide a much needed alternative route from North Nowra to the Princes Highway, alleviating pressure on the Princes Highway in the critical link across the Shoalhaven River between Bolong Road (to the north) and Bridge Road (to the south). It will also give an opportunity for motorists travelling to/from North Nowra to avoid this part of the network, resulting in marked improvement to network operations and local accessibility and will improve safety along the length of Illaroo Road.

The NBSP identified a link road as being justified in the short term, regardless of new developments in North Nowra/Bomaderry, and has the potential to defer a new crossing of the Shoalhaven River.

However, the NBSP identifies that the link road is an integral part of the plan, because it would enhance the capacity of the existing road network and allow it to accommodate the needs of current and future residents. Should that link not be provided, the feasibility of directing new growth to North Nowra could be seriously compromised.

11.4 Analysis of Potential Land Use Conflicts

Figure 11.1 shows the location of each of the three options against the current land use zoning.

Figure 11.2 shows the location of each of the three options against the current land uses.

The detailed plans provided in **Appendix C** show the land that would be affected by the corridor and proposed alignment for each route option. The sections below describe the land and land users that would be affected by each route option.

Biodiversity issues associated with impacts within the Bomaderry Regional Park are addressed in Section 13.

Figure 11-1: The Location of the Three Route Corridors against Current Land Use Zoning

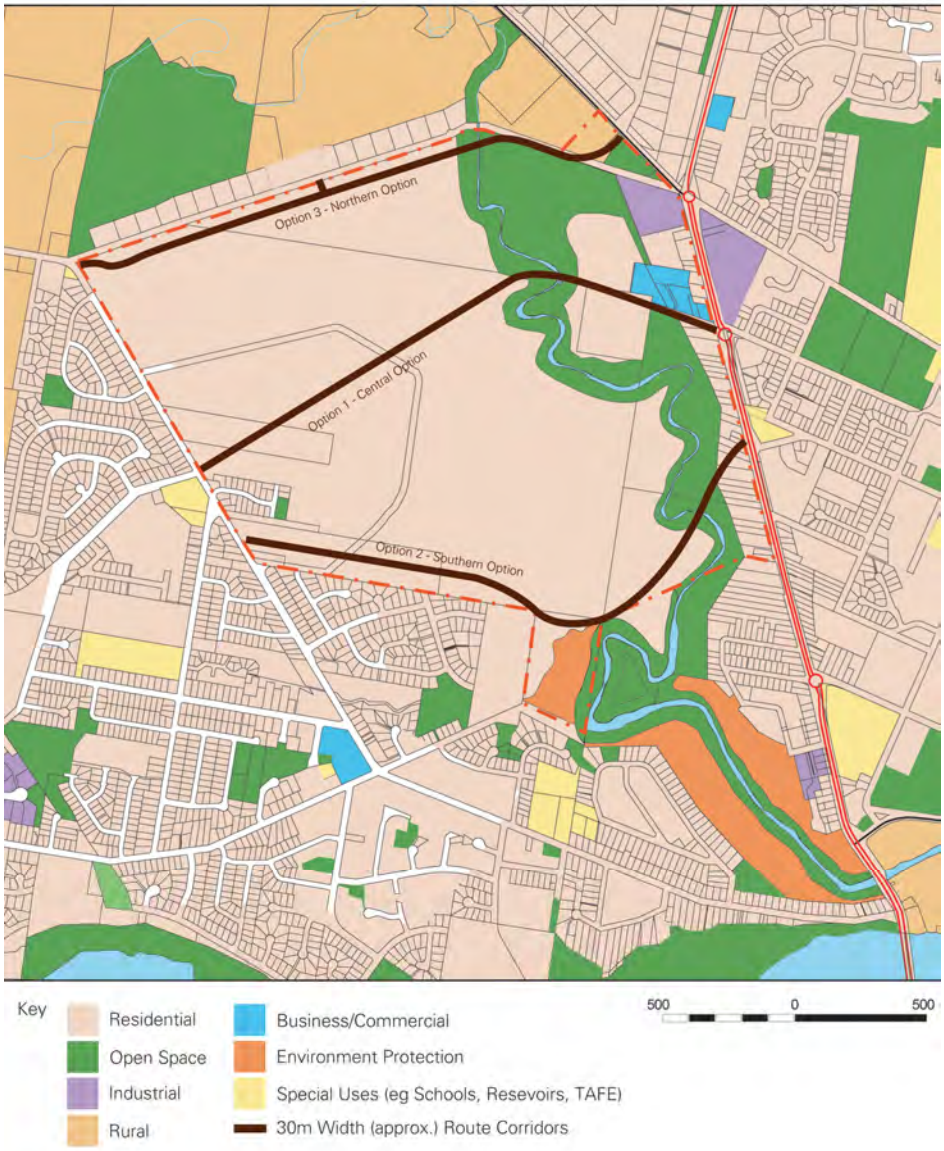
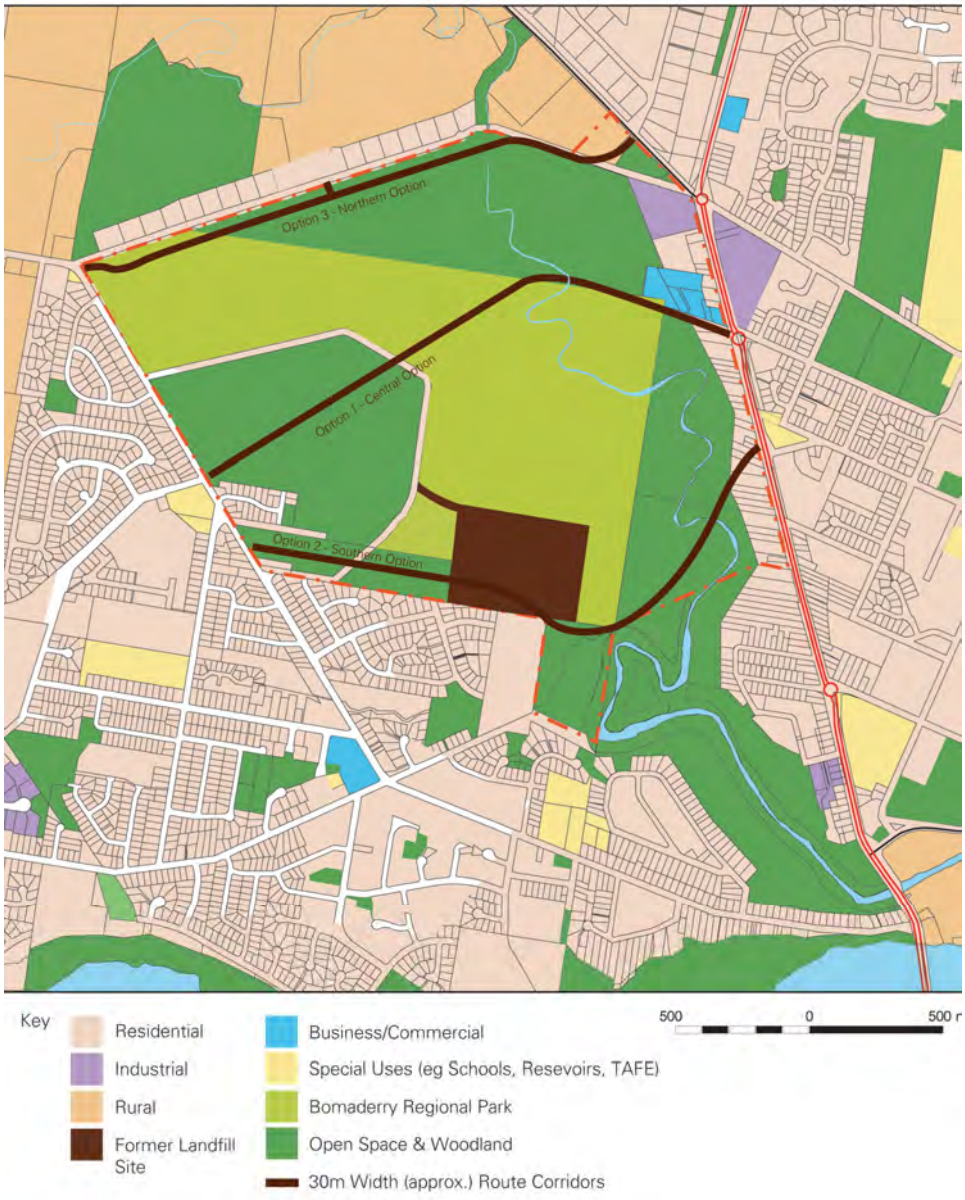


Figure 11-2: The Location of the Three Route Corridors against Current Land Uses



11.4.1 Option 1 (The Central Option) – Impacted Land and Land Uses

The Central Option would traverse land that is predominantly zoned for residential uses, but is currently uncleared vegetation, in part within the Bomaderry Regional Park. The land affected by the Central Option is, starting from the west:

- Crown Land being the land subject to Aboriginal Land Claims ALC 6379 and ALC 6380
- Part Lot 7012 DP 1002215 being the Bomaderry Creek Regional Park.
- A small portion of Council owned land immediately to the north of the Regional Park being 108 DP 131063 and Lot 109 DP 3060.
- The existing road corridor for Narang Road.

Impact to Private Residences

At the western end there are ten residences on the north side of Byron Avenue and three adjacent residences on Emerson Street. The route would pass within approximately 30m of the closest residence on Byron Avenue and approximately 120m from the furthest residence on Byron Avenue, with the road diverging from residential properties as it moves eastwards. There would be a noise impact on residential properties at Byron Avenue, which would be addressed through the provision of a noise barrier or berm at the western end, and the lowering of the traffic speed limit to 60 kph. Because of the alignment of Option 1 the road would diverge from the residences on Byron Avenue within a short distance, minimising potential impacts.

The land bounded by the Bomaderry creek Regional Park (nominally Falcon Crescent) and Illaroo Road has been identified as a possible future living area, an area that would be impacted directly by the Central Option.

At the eastern end the route would pass approximately 30m from residences in Narang Road, however the alignment is within the existing road reserve.

Services Infrastructure

A 600mm diameter potable water trunk main servicing Bomaderry, Shoalhaven Heads and some of the rural areas and an Integral Energy 33kV power line serving North Nowra currently exist within a cleared service road along which the Central Option generally follows. Council would incorporate the existing pipeline crossing of Bomaderry Creek into the bridge structure for the Central Option. A photograph of the existing pipeline crossing is given in **Figure 6.6**.

Integral Energy would be likely to integrate the existing 33kV transmission line into the road reserve for the Central Option, which would provide better operational and maintenance access. Integral Energy has also indicated that it may need to upgrade the existing power line. If the Central Option is approved then the road easement would be able to accommodate the upgraded power line.

Further to the east, the Central Option ties into Narang Road, an existing partially formed public road that connects with a completed roundabout on the Princes Highway. Utilities services located within the Narang Road reserve may be impacted by the Central Option.

Electricity infrastructure on the eastern side of Illaroo Road is likely to be required to be relocated as part of the potential new intersection at Illaroo Road.

Amenity Within Bomaderry Creek Regional Park

The Central Option would result in improved acces for visitors on the walking track on the east side of Bomaderry Creek, which provides access from the Park entrance and facilities area down to the Bomaderry Creek Weir.

The walking trail for Bernies Lookout also starts within the Regional Park grounds, and would cross underneath the proposed bridge for the Central Option.

There is a third walking trail which connects the Bomaderry Creek walking trails with West Cambewarra Road, which would be severed by the Central Option.

With this route option it is proposed to modify or relocate these walking trails to accommodate the road and bridge for the Central Option and to improve public access to the Regional Park and its facilities.

The principle loss of amenity would relate to increased traffic noise and visual impact from the road and bridge structure in the vicinity of the Bomaderry Creek Weir, although the existing water pipeline crossing already makes a significant visual amenity intrusion.

The location of the North Nowra Link Road on the Central Option would provide for improved awareness of the Regional Park and its facilities, including the Bomaderry Creek Weir, by increasing the amount of passing traffic.

It would also provide for improved surveillance by passing traffic of parts of the Park. In particular, the current behaviour near and inside the Bomaderry Creek Regional Park is aggravated by a lack of supervision and exposure to other people using the area. There have been a number of dumped cars along the alignment for the Central Option because there is currently good access provided by the existing transmission line and water pipeline service road. Increased surveillance of passing traffic and appropriately placed traffic barriers will curtail anti-social behaviour in this section of the Park.

The construction of Option 1 would increase the potential to give the North Nowra and Bomaderry communities a greater sense of pride and ownership of the Regional Park.

11.4.2 Option 2 (The Southern Option) – Impacted Land and Land Uses

The Southern Option would affect:

- Vacant Crown Land affected by Aboriginal Land claim No. 6696, which is currently wooded and located between the residential areas of Falcon Crescent (to the south) and Byron Avenue (to the north).
- Crown Land which is occupied by Council for the management of leachate from a former landfill site.
- Lots 118 and 119 DP751258 (off Jamieson Road) to the south of the former landfill site. Lot 118 has been recently approved for a residential subdivision.
- A small section at the south-eastern corner boundary of Bomaderry Creek Regional Park,
- Council land zoned residential 2(c) which is located on the plateau to the west of the Bomaderry creek Gorge.
- Council land zone 6(a) and 6(c) being conservation zones protecting the Bomaderry Creek and Gorge.
- Three privately owned residential lots zoned 2(a1) on the Princes Highway, which would be required to be acquired by Council for the road.

Impact to Private Residences

The route would pass approximately 60m north of residences on Falcon Crescent, Narrien Place, Wingello Close, Warren Avenue, 30m north of residences on Sutherland Drive. In addition to directly affecting residential properties fronting the Princes Highway the Southern Option would be within 15m of nearby residential properties on the Princes Highway.

Three of the privately owned residential lots would be directly affected at the eastern end, and the residential dwelling at these properties would be required to be demolished. Two other lots would be potentially affected, albeit only marginally, and Council may be required to acquire a small amount of these two additional lots.

Services Infrastructure

The existing local electricity transmission lines are located on the eastern side of Illaroo Road, where it would connect with the Southern Option. Relocation of existing power poles may be needed as part of the intersection works. At its eastern end the Southern Route would impact on the sewer main and gas reticulation infrastructure, and further investigation of protection and treatments would be needed during the design phase.

Amenity Within Bomaderry Creek Regional Park

The impact of the Southern Option to the Bomaderry Creek Regional Park is minimal, being the south-eastern corner of the park, which is located well away from park access points and walking trails which are located further to the north. The impacted part of the Regional Park is also adjacent to the now closed landfill site, which is currently being rehabilitated, and is separated from the rest of the Regional Park by a partially cleared area of land that appears to be used for dirt biking.

Notwithstanding that the impact to amenity area within the Bomaderry Creek Regional Park is low, the impact of the Southern Option to amenity areas on Council owned land immediately adjacent to the Regional Park within and surrounding the Bomaderry Creek Gorge is significant. In particular the long walking trail shown in **Figure 11.3** and **Figure 11.4** follows the Bomaderry Creek Gorge leaving the Park to the east and following the Gorge South through Council land. Where the Southern Option crosses the Gorge is along this walking trail, at one of the most visually prominent locations, where the Gorge is approximately 30 metres deep.

Figure 11-3: Photograph of the Bomaderry Creek Gorge where the Southern Option would Bridge Across

Figure 11-4: Photograph of the Bomaderry Creek Gorge where the Southern Option would Bridge Across

11.4.3 Option 3 (The Northern Option) – Impacted Land and Land Uses

The Northern Option would traverse land that is predominantly zoned for residential uses, but is currently uncleared vegetation, in part within the Bomaderry Regional Park.

Impact to Private Residences

There is a 10 metre wide offset from the existing road reservation to the northern boundary of the Regional Park. This would be insufficient to cater for the Northern Route Option and the necessary acoustic barriers. The Northern Option would pass within 50 m of the 19 residential properties on West Cambewarra Road, which would look over the new road and the acoustic treatments, significantly impacting on the amenity currently experienced at the entrances to these residential properties.

East of the current ending point of West Cambewarra Road the Northern Option would be able to use, in part, the paper road corridor shown on the zoning map. At its eastern end, after crossing Bomaderry Creek, the Northern Option turns sharply to the north to create a new connection with Moss Vale Road, requiring an upgrade to the existing intersection of Moss Vale Road and Elvin Drive.

One parcel of privately held land would be directly impacted by the Northern Option, being Lot 110 DP 131219. Acquisition would be required directly impacting upon the stock sale yards business that is in operation on the land.

The Northern Option would also impact directly on the land that is identified in the NBSP as being Potential New Living Area.

Services Infrastructure

The Northern Option would affect existing local electricity transmission lines and water reticulation infrastructure at its western end, and Optus optic fibre cabling infrastructure at its western end. These services would need to be considered during subsequent stages of design.

Amenity Within Bomaderry Creek Regional Park

The impact of the Northern Option to the Regional Park is minimal, being in the north-western corner of the park, well away from park access points, Bomaderry Creek and walking trails which are located further to the southeast.

11.5 Comparison of Route Options

Table 11.1 shows a comparative ranking of each of the route options against the key land use parameters, which are:

- Impacts to the amenity of users of the Bomaderry Creek Regional Park, including the walking tracks in the Regional Park and on the adjacent land through the Bomaderry Creek Gorge.
- Amenity impacts to existing private residences and potential new residences.
- Direct impact to private land requiring acquisition.

The score for each parameter is the ranking for each route option, 1 being the best performing option and 3 being the worst performing option for a particular parameter. The total scores provided in the table are the sum of the ranking score for each parameter, and a lower score is the best result, showing that an option has ranked well across the most parameters.

As can be seen in **Table 11.1** there is no clear distinction between the route options with consideration of the land use impacts. This is because:

- The Central Option performs comparatively poorly in relation to impacts to the amenity of people using the facilities in Bomaderry Creek Regional Park but has least impact on existing residential areas and private property.
- The Northern Option has less impact to the Bomaderry Creek Regional Park and minimal impact on the Bomaderry Creek Gorge but performs poorly in relation to impact on existing residential areas.
- The Southern Option has less impact to the Bomaderry Creek Regional Park but performs poorly in relation to direct and indirect impacts on private land and impacts to the Bomaderry Creek Gorge.

Table 11-2: Comparison of Route Options Against Land Use Impacts

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Impact to Bomaderry Creek Regional Park (Amenity)	3	1	1
Impact to Bomaderry Creek Gorge (Amenity)	2	3	1
Indirect Impacts to Existing Residential Areas	1	3	2
Direct Impact to Potential New Residential Areas	3	1	3
Direct Impact to Private Land (Residential or Business) which Requires Acquisition	1	3	2
Total Score	**10**	**11**	**9**

Note: The lowest score is the best performing route option.

Note: Impacts to services infrastructure are not considered a major differentiator between route options since the required utility relocations and treatments are reasonably standard and result in costs within the contingencies used for cost comparison.

12.0 Transport and Accessibility

The information in this Section is sourced from the AECOM North Nowra to Bomaderry Link Road Options Study provided in **Appendix E**.

AECOM's PARAMICS model was used to establish the advantages and disadvantages of each proposed North Nowra Link Road options by considering traffic benefits and dis-benefits of each option with reference to the "Do Nothing" scenario. In this way the significance of the predicted benefit or dis-benefit was determined and a preferred corridor for the link road was identified.

As described in Section 3.4 the traffic model was already operating at practical capacity by 2016 being constrained by the Princes Highway in the vicinity of the existing Shoalhaven River bridges. As such lower growth scenarios were used, and the model limited to 2016 to ensure that the model remained operational and continued to provide results that were able to differentiate the route options. Whilst the limitations need to be taken into account it is highlighted that any new model will be subject to the same limitations and will therefore not be able to provide any results that are substantially more accurate, meaningful or forward looking.

In addition to the "Do Nothing" scenarios (being the AM and PM peak period 2016 model with no improvements to the traffic network), and based on a high and a low growth scenario also previously described, the model was run with each of the 3 selected route options for the AM and PM peak period in 2016 based on the high growth scenario. A standard and consistent speed limit of 70 km/hour was applied for modelling purposes. Because of the proposed actual speed limits (see Section 7 for the proposed speed limit on each route option) it is likely that the modelling results presented below have under-represented the benefits of the Central Option and the Southern Option and would have over-represented the benefits of the Northern Option if it was constructed along the existing West Cambewarra Road. This comparative affect has been avoided through the refinement to the Northern Option to the south of West Cambewarra Road.

The traffic assignment method used for future year modelling is "Dynamic Feedback" with a feedback period of two minutes. Dynamic feedback assignment assumes drivers that are familiar with the road network will re-route if congestion is experienced on the road network and an alternative route with less delay is available. Dynamic feedback will accurately account for the usage of the Link Road and rat-running that occurs as a result of the road network being more congested.

A two-minute feedback period was chosen because it is an appropriate length of time that could allow vehicles to re-route if necessary given the size of the road network. A longer (>2 minutes) feedback period would not provide enough opportunities for vehicles to re-route as it exceeds the travel time of some routes throughout the network. A shorter (<1 minute) feedback period would provide excessive re-routing opportunities and result in impractical travel behaviour within the network.

In general terms, it is expected that the development of a Link Road will improve the overall level of accessibility to the North Nowra area, particularly for local trips between Bomaderry and North Nowra as well more strategic trips travelling between North Nowra and regions to the north and east. By using the Link Road, these trips (approximately 30% of the traffic using the intersection) will be provided with the opportunity to avoid the congestion on Illaroo Road, and to avoid the Illaroo Road/Princes Highway intersection. This will reduce travel times for these trips on the network, as well as remove these trips from Illaroo Road, and Illaroo Road/Princes Highway intersection improving the performance of the intersection.

12.1 Assessment of Traffic Network Performance Measures

Vehicle hours travelled (VHT) and vehicle kilometres travelled (VKT) are key performance measures that authorities aim to minimise in network planning and this is a transport objective of the NSW State Plan, the Nowra Bomaderry Structure Plan and a strategic objective of the NSW Government's Integrated Land Use and transport Strategy. Apart from the economic benefits of improved travel efficiencies, minimisation of VHT and VKT results in less vehicle emissions and therefore less pollution levels, providing considerable benefit to the environment and the community.

The network performance measures indicate the overall functional performance of the operation of the entire modelled network, which is shown in **Table 12.1**, and includes traffic travelling along the Princes Highway and Bolong Road, as well as traffic on Illaroo Road. It is important to keep in mind that this assessment demonstrates the overall fit of the proposed network solution in the context of the entire network, rather than just the specific road or intersection of interest.

Table 12-1: Comparison of Network Performance Measures

Scenario AM Peak Modelling	VKT	VHT	Average Speed
2005 – Base Year	14,424	357	40
2016 – Low Growth	15,485	447	35
2016 – High Growth	17,153	709	24
2016 – Central Option	17,887	672	27
2016 – Southern Option	17,433	663	26
2016 – Northern Option	18.089	705	26
PM Peak Modelling	**VKT**	**VHT**	**Average Speed**
2005 – Base Year	15,704	376	42
2016 – Low Growth	16,387	403	41
2016 – High Growth	19,049	903	21
2016 – Central Option	19,687	854	23
2016 – Southern Option	19,626	832	24
2016 – Northern Option	19,717	965	20

VHT and Average Speed are good indicators of the level of congestion and the overall efficiency across the entire traffic network.

Table 12.1 shows that VHT is lowest for the Southern Option with decreasing benefit for the more northerly Central Option and the least benefit for the Northern Option for both the AM and PM peak periods. This is consistent with the Average Speed highest for the Southern Option and decreasing for the Northern Option. In fact, there is no apparent travel time benefit with the northern option, with the assessment showing that during the PM peak period the Northern Option has a lower network efficiency (higher VHT) compared to the Do Nothing option (High Growth scenario).

This trend is expected considering the centre of gravity of trip generation in North Nowra being south of the new intersection between the North Nowra Link Road and Illaroo Road, and the high percentage (approximately 70%) of existing movements on Illaroo Road which have destinations south of the river. Whilst in very congested peak conditions significant re-routing could occur for all route options, the consequences of longer re-routing are longer VKTs and higher VHTs, resulting in a reduced community benefit and worse environmental conditions.

12.2 Assessment of Link Road Usage

The success of meeting the project objectives is largely dependent on how many people would use the Link Road. **Table 12.2** shows the number of vehicles that are modelled to use the Link Road for each of the options.

Forecasts indicate that approximately 450 to 540 vehicles will use the Link Road during the AM or PM peak hour under each of the different scenarios tested. This accounts for approximately 23% to 26% of the total projected AM and PM peak hour traffic into/out of North Nowra.

There is generally less traffic on the Link Road during the PM peak when compared with the AM peak in each scenario. This is due to less delays being experienced by vehicles returning to North Nowra using the current northbound left-turn slip lane at Illaroo Road intersection, which is a more significant proportion of the total traffic movements during the PM peak.

Table 12-2: Use of the Link Road

Scenario AM Peak Modelling	Total Traffic On Link Road	Link Road – Out of North Nowra	Link Road – in to North Nowra	Total Traffic on Illaroo Road
2016 – Low Growth	-	-	-	1598
2016 – High Growth	-	-	-	1779
2016 – Central Option	536	412	124	1520
2016 – Southern Option	480	371	109	1458
2016 – Northern Option	450	348	102	1496
Scenario PM Peak Modelling	**Total Traffic On Link Road**	**Link Road – Out of North Nowra**	**Link Road – in to North Nowra**	**Total Traffic on Illaroo Road**
2016 – Low Growth	-	-	-	1636
2016 – High Growth	-	-	-	1894
2016 – Central Option	499	291	208	1520
2016 – Southern Option	460	267	193	1609
2016 – Northern Option	478	278	200	1538

Because of the very congested peak hour conditions, the option with the greatest potential to optimise movements of traffic into/out of North Nowra within a given peak hour is generally the best network option (i.e. with greater absorption capacity to the Highway) in transport terms. This is more critical in the congested AM peak with a significant amount of traffic trying to leave North Nowra and access the Highway. In this regard Option 1 is the best performing option.

Whilst the southern option is closer to the centre of gravity for most trip making, in the congested peak hour the southern option did not attract more traffic than the central option and this is primarily because the existing roundabout at Narang Road has superior capacity than the traffic signals that would otherwise be required at West Bunberra Street. The additional travel time required as consequence of diversion to the Central route however resulted in the Central route having marginally higher VHT than the southern route.

In addition to peak hour modelling, Council's TRACKS traffic models were able to estimate traffic volumes along each of the link road options as shown in **Table 12.3**. In all cases there is a significant level of forecast usage of a Link Road. Across the whole day approximately 25% of traffic is projected to use Illaroo Road for the Central and Southern Options, dropping to about 15% for the Northern Option.

This shows that while the Northern Option provides a similar amount of relief during the peak periods as Options 1 and 2, it is not utilised as much outside of the peak periods. This is likely to reflect the highly congested nature of the traffic network during the peak periods and indicates that significant benefits would also be extended to the community outside the peak periods due to improved accessibility provided by a new link road, particularly along the central or southern routes.

Table 12-3: Future Traffic on Link Road Options

	Link Road Traffic Demand 2010	Link Road Traffic Demand 2036	Potential Traffic on Illaroo Road in 2036
Central Option	7,500 vpd	9,000 vpd	30,000 vpd (18,000 vpd[1])
Southern Option	8,500 vpd	10,000 vpd	29,000 vpd (17,000 vpd[1])
Northern Option	5,500 vpd	6,000 vpd	33,000 vpd (21,000 vpd[1])

Note 1: The modelled traffic demand on Illaroo Road in 2036 if access were provided from North Nowra to/from the Western Bypass (6,000 vpd) and following construction of the Moss Vale to Illaroo Road link in accordance with the Nowra Bomaderry Structure Plan (6,000 vpd).

The TRACKS data in **Table 12.3** indicates that only the Central and Southern link road options have the potential to contain traffic volumes to current levels (18,000 vpd) on Illaroo Road, another key parameter when assessing the appropriateness of the link road alignment in the context of ultimate development as envisaged under the Nowra Bomaderry Structure Plan.

12.3 Assessment of Travel Times

Travel times were extracted from each of the 2005 and 2016 Paramics models for the following key routes:

- Route 1: Bridge Road to Illaroo Road.
- Route 2: Illaroo Road to Bridge Road.
- Route 3: Princes Highway South to Princes Highway North.
- Route 4: Princes Highway North to Princes Highway South.
- Route 5: Moss Vale Road to Bolong Road.
- Route 6: Bolong Road to Moss Vale Road.
- Route 7: West Bunberra Street to Bolong Road.
- Route 8: Bolong Road to West Bunberra Street.

The key routes of interest in meeting the project objectives are Route 1 and Route 2 being the critical journey, north bound and south bound respectively, between Illaroo Road and south of the Shoalhaven River bridges.

The average travel times along this route for each of the route options is provided in **Table 12.4** below.

Route 1 is the north-bound journey with trip generating south of the Shoalhaven River and turning into North Nowra, currently via Illaroo Road. Because of the existing slip lane for vehicles turning left from the Princes Highway into Illaroo Road it is clear that this journey is less constrained during both the AM and PM peak periods. Route 2 is the same journey but travelling in the southbound direction from North Nowra to the Shoalhaven River bridges. Route 2 is therefore the critical journey, especially during the AM peak period, with the right-turn into the Princes Highway highly constrained.

Table 12-4: Route 1 and Route 2 Travel Times

Scenario AM Peak Modelling	Route 1 Average Travel Time (into North Nowra)	Route 2 Average Travel Time (out of North Nowra)
2005 – Base Year	4:11	5:59
2016 – Low Growth	4:11	7:42
2016 – High Growth	4:18	11:52
2016 – Central Option	4:28	9:24
2016 – Northern Option	4:21	9:56
2016 – Southern Option	4:18	9:48
Scenario PM Peak Modelling	**Route 1 Average Travel Time (into North Nowra)**	**Route 2 Average Travel Time (out of North Nowra)**
2005 – Base Year	4:17	5:55
2016 – Low Growth	4:21	5:48
2016 – High Growth	7:58	12:32
2016 – Central Option	5:47	11:18
2016 – Northern Option	6:43	11:12
2016 – Southern Option	4:50	11:41

The table above indicates that in terms of average travel times all three of the North Nowra Link Road options demonstrate a benefit to Illaroo Road traffic conditions compared with the do-nothing option, saving approximately 2-3 minutes from the critical Route 2 journey in the AM peak. In the AM peak, when there is a large trip generation from North Nowra then the Central Option shows the highest benefit. In the PM peak the key movement is Route 1 travelling north-bound into North Nowra. The benefit from the North Nowra Link Road would be approximately 1-3 minutes when travelling into North Nowra, with the Southern Option providing the highest benefit.

In critical peak periods travel time benefits are constrained due to the high proportion of traffic with a destination south of the river and the congestion on the Princes Highway at the Shoalhaven River bridges. The travel routes subject of travel-time analysis were those that can be directly measured now for validation of the base models and for assessment of any change from the inclusion of a new link road. What was not included in the AECOM traffic study was the significant decrease in travel time for those 30% of motorists that do not have a destination south of the river but who are usually caught up in the congestion on Illaroo Road and the intersection with the Princes Highway. While the travel-time assessment is useful, a better indicator of this improvement in the overall network efficiency is the VHT parameter which is described in Section 12.1.

12.4 Assessment of Intersection Performance

SIDRA intersection analysis was carried out on the thirteen key intersections for each of the different scenarios modelled to compare in detail the performance and operation of each intersection.

SIDRA analyses intersections in isolation and in situations where significant congestion occurs upstream and downstream of an intersection, SIDRA can often underestimate the junction performance. Based on the initial SIDRA results and observations from the Paramics modelling, in particular along Princes Highway, Illaroo Road and Bolong Road, it was concluded that SIDRA was not accurately measuring intersection performance.

To ensure that vehicle throughput, as well as the queuing observed upstream and downstream to/from each intersection was accurately being modelled, the main performance indicators (listed below) were extracted from Paramics to provide a more accurate comparison between the different scenarios.

These include:

- Average delay – length of time (in seconds) the average vehicle waits at the intersection; and
- Level of service – a measure of the overall performance of the intersection.

Table 12.5 summarises the performance of the key intersections along Illaroo Road that were modelled in Paramics for the AM (8-9AM) and PM (3.30-4.30PM) peak periods respectively in 2005 and 2016 for each of the scenarios modelled.

The RTA recommended performance standard during the weekday peak hour is Level of Service (LOS) C or better. The intersections that operate at an unsatisfactory Level of Service (that is, Level of Service D or worse) have been highlighted in **Table 12.5** where orange represents a LOS D, pink represents a LOS E and red represents a LOS F.

Table 12-5: Level of Service at 2 Key Intersections on Illaroo Road

AM Peak Modelling	Illaroo Road/McMahons Road Intersection	Illaroo Road/Princes Highway Intersection
Scenario	LOS, Average delay (s)	LOS, Average delay (s)
2005 – Base Year	LOS A, 2 seconds	LOS C, 34 seconds
2016 – Low Growth	LOS A, 3 seconds	LOS E, 62 seconds
2016 – High Growth	LOS B, 18 seconds	LOS F, 122 seconds
2016 – Central Option	LOS A, 4 seconds	LOS F, 96 seconds
2016 – Northern Option	LOS A, 3 seconds	LOS F, 103 seconds
2016 – Southern Option	LOS A, 4 seconds	LOS F, 97 seconds
PM Peak Modelling	**Illaroo Road/McMahons Road Intersection**	**Illaroo Road/Princes Highway Intersection**
Scenario	LOS, Average delay (s)	LOS, Average delay (s)
2005 – Base Year	LOS A, 4 seconds	LOS B, 25 seconds
2016 – Low Growth	LOS A, 4 seconds	LOS F, 94 seconds
2016 – High Growth	LOS A, 6 seconds	LOS F, 131 seconds
2016 – Central Option	LOS A, 4 seconds	LOS F, 94 seconds
2016 – Northern Option	LOS A, 4 seconds	LOS F, 113 seconds
2016 – Southern Option	LOS A, 5 seconds	LOS F, 79 seconds

The decrease in Level of Service at Princes Highway/Illaroo Road intersection highlights the need for intersection improvements to be introduced with background traffic growth alone. Even the low growth scenario which included only background traffic growth along the Highway and Bolong Road (no growth in North Nowra) highlighted marked deterioration of conditions at Highway / Illaroo Road intersection, with worsened conditions when factoring in the impacts of growth under the NBSP.

Extensive queuing was observed in the AM peak Paramics model at the intersection of Princes Highway/Illaroo Road. The queues on Illaroo Road (western approach) extended up to Pitt Street (approximately 2km) and on Princes Highway (northern approach) up to West Bunberra Street by the end of the peak hour (approximately 800m).

The queues generated on Illaroo Road affect the operation of the minor roads connecting to Illaroo Road. This is shown above by the increase in average at the Illaroo Road / McMahons Road intersection experienced from 2 seconds (LOS A) to 18 seconds (LOS B).

The improvement in Level of Service during the AM peak at the McMahons Road intersections with Illaroo Road indicates that Illaroo Road will become less congested with the construction of any of the Link Roads and the flow of traffic will improve from residential roads onto Illaroo Road.

While the Princes Highway / Illaroo Road intersection was observed to operate at a Level of Service F for all scenarios modelled in 2016 it should be noted that the overall average vehicle delay did improve considerably with the construction of the Link Road.

The models show maximum improvement in overall intersection performance at Princes Highway and Illaroo Road as a result of Central and Southern Link Road options.

12.5 Assessment of Impact on Surrounding Road Network

12.5.1 Intersection Performance at Bolong Road and Princes Highway

The models show a general worsening in overall intersection performance at Princes Highway and Bolong Road as a result of construction of the North Nowra Link Road when modelled in isolation of any other improvements. When modelled in isolation, there are no instances where the performance level was improved. This is due to extensive queuing along Bolong Road, and also on the northern approach of the Princes Highway / Bolong Road intersection, which would be exacerbated by additional southbound traffic from North Nowra passing through this intersection, where it would normally only pass through the Illaroo Road/Princes Highway intersection.

The impact on the Level of Service performance of the Bolong Road and Princess Highway intersection is provided in **Table 12.6**.

Table 12-6: Level of Service at Intersection of Bolong Road and Princes Highway

	AM Peak Modelling	PM Peak Modelling
Scenario	LOS, Average delay (s)	LOS, Average delay (s)
2005 – Base Year	LOS B, 23 seconds	LOS B, 26 seconds
2016 – Low Growth	LOS C, 29 seconds	LOS F, 82 seconds
2016 – High Growth	LOS E, 65 seconds	LOS D, 43 seconds
2016 – Central Option	LOS F, 88 seconds	LOS F, 82 seconds
2016 – Northern Option	LOS F, 82 seconds	LOS F, 94 seconds
2016 – Southern Option	LOS F, 81 seconds	LOS E, 70 seconds

However, as discussed further in Section 12.6, when modelled in conjunction with the Illaroo Road to Moss Vale Road Link, and the short term low relative cost improvements to extend the capacity of the Shoalhaven River bridges (river crossing relief or 'RCR' option), conditions at Highway / Bolong Road were seen to improve considerably in some cases to conditions equivalent ~~to~~, or better than the Do Nothing option. The results indicate that as the NNLR contributes directly to improved overall network performance (as described in Section 12.1); it is not the NNLR, but more so the capacity constraints on the Highway that contribute to the impacts at Princes Highway / Bolong Road intersection predicted in this section. In this context it is considered that the NNLR is an important element of the overall infrastructure improvements (including Highway upgrade) required to improve network performance and cater for future growth.

12.5.2 Local Roads

Beinda Street, Bunberra Street, and Cambewarra Road all experience an increase in traffic as a result of development envisaged under the NBSP (up to 150 vph during the peak hour or 1500-1800 vpd).

Further increases in traffic are likely to occur on these roads as a result of the construction of a North Nowra Link Road irrespective of the option (up to 103 vph during the peak hour or 1000-1300 vpd), when traffic reroutes between North Nowra and Bomaderry. It should be highlighted that traffic rerouting between the North Nowra and Bomaderry via the North Nowra Link Road would be traffic that is removed from the most constrained part of the Princes Highway between Bolong Road and Bridge Street.

The option with the least potential to increase traffic on Bomaderry collector roads is the Option 1 (Central Option). Unlike the Northern and Southern options the Central Option is the only route that does not connect directly to a major collector road in Bomaderry, and this allows a considerable community benefit from the link road without unreasonable direct impacts on residents along the existing collector roads in Bomaderry.

12.6 Assessment of Fit with Proposed Future Road Network

In addition to the North Nowra Link Road there are two additional road improvements that are likely to be required in the short to medium term and which would help to manage traffic levels on Illaroo Road. These are:

- The Moss Vale Link Road: This new road link is identified in the NBSP as part of the growth of New Living Areas around Moss Vale Road, and would link the north of Illaroo Road (at the intersection with West Cambewarra Road) with Moss Vale Road. The timing for the provision of this infrastructure is subject to market conditions and the timing of the development of the Moss Vale South new living area. The primary role of this new road is to mitigate the impacts of the new living area on Moss Vale Road and the Princes Highway by connecting communities and providing a two-way access between the new living areas and the shops, schools and services in greater North Nowra.
- The River Crossing Relief Improvements: include the following schemes to improve traffic flows across the Shoalhaven River bridges:
    - Inclusion of an additional left turn approach lane from Illaroo Road to Princes Highway.
    - Separation of Pleasant Way from Princes Highway / Bridge Road intersection.

Table 12.7 shows the key traffic indicators for 2 additional options, being the Central Option in combination with the Moss Vale Link Road (MVLR) and in combination with the RCR improvements. The combination shows how the North Nowra Link Road works in tandem with these other proposed road improvements to improve the overall efficiency of the traffic network.

As shown in the Table, the North Nowra Link Road in combination with the proposed 2 additional improvements to the network results in further beneficial affect on the network. In all cases the traffic parameter improves, except for the northbound travel time for traffic travelling from the Princes Highway (south of the bridges) to Illaroo Road.

This shows an increase in travel time once the Moss Vale Link Road is included in the network analysis, since a new connection to Moss Vale Road will be provided via Illaroo Road diverting some traffic from the Princes Highway.

Whilst this may appear as an adverse effect, this diversion demonstrates the added effectiveness of the MVRDLK to optimise conditions on Moss Vale Road and Princes Highway, as overall best network performance (lowest VHT) is apparent with this option, and due to other traffic diversions from Illaroo Road to the MVRDLK and the NNLR, Illaroo Road has the ability to absorb minor diversions of traffic such as this with no adverse consequence.

Secondly, the other important parameter is the Level of Service of the Bolong Road/Princes Highway intersection. In both cases, the LOS of this intersection is improved to a similar level as without the North Nowra Link Road, once the Moss Vale Road Link Road or the RCR improvements have been implemented, thereby offsetting the marginal adverse impact of the NNLR being considered in isolation of other road improvements.

Table 12-7: Key traffic Indicators For Assessment of Impact to Future Road Improvements

Traffic Parameter **AM Peak Modelling**	**2016 – Central Option**	**2016 – Central Option + RCR**	**2016 – Central Option + MVLR**
VHT	672	614	599
Mean Speed	27	29	30
No. of Vehicles on Modelled Network	8,013	7,852	7,987
No. of Vehicles on Link Road	536	611	472
Travel Times – Route 1 (north bound)	4:28	4:17	4:19
Travel Times – Route 2 (south bound)	9:24	8:43	8:27
LoS – Illaroo Road/ McMahons Road Intersection (LOS and Average Delay)	LOS A 4 s	LOS A 3 s	LOS A 3 s
LoS – Illaroo Road/ Princes Highway Intersection (LOS and Average Delay)	LOS F 96 s	LOS F 88 seconds	LOS F 78 s
LoS – Bolong Road/ Princes Highway Intersection (LOS and Average Delay)	LOS F 88 s	LOS F 77 s	LOS E 66 s
Traffic Parameter **PM Peak Modelling**	**2016 – Central Option**	**2016 – Central Option + RCR**	**2016 – Central Option + MVLR**
VHT	854	696	818
Mean Speed	23	29	24
No. of Vehicles on Modelled Network	8,727	8,523	8,703
No. of Vehicles on Link Road	499	519	389
Travel Times – Route 1 (north bound)	5:47	5:02	7:16
Travel Times – Route 2 (south bound)	11:18	9:03	9:34
LoS – Illaroo Road/ McMahons Road Intersection	LOS A 4 s	LOS A 4 s	LOS A 4 s
LoS – Illaroo Road/ Princes Highway Intersection	LOS F 94 s	LOS D 50 s	LOS F 75 s
LoS – Bolong Road/ Princes Highway Intersection	LOS F 82 s	LOS C 40 s	LOS D 56 s

12.7 Modelling Conclusions

Key conclusions of the road traffic network modelling are:

- Traffic volumes and flows along Illaroo Road and queuing and average delays on Illaroo Road at the Princes Highway intersection are significantly reduced with any North Nowra Link Road. This is likely to improve amenity of local residents, and minimise accident rates on Illaroo Road, offsetting the need for further safety improvements such as additional signals.
- Travel times on Illaroo Road for vehicles travelling south on the Princes Highway are improved.
- The level of service (LOS) at the Princes Highway/Illaroo Road intersection remains at F, however average vehicle delays are reduced with a North Nowra Link Road.
- Whilst the Central and Southern NNLR options would providesubstantial overall network benefits, when considered in isolation all link road options reduce performance at the Bolong Road/Princes Highway intersection. This would be expected since some of the traffic travelling south from North Nowra would re-direct away from Illaroo Road to the Princes Highway, and therefore pass through this intersection. However, this can be offset with a Moss Vale Road Link Road and RCR improvements (including an additional left turn lane on Illaroo Road approach to the Princes Highway and separation of Pleasant Way from the Princes Highway / Bridge Rd intersection).
- Both the Central and Southern route options would provide marked travel time savings network wide, whereas there is no apparent travel time benefit with the Northern Option; in fact in the PM peak period the northern option was assessed as reducing network efficiency (i.e. higher VHT) compared to the Do Nothing option.
- Only the Central and Southern link road options have the potential to contain traffic volumes to current levels (i.e. approximately 18,000vpd) on Illaroo Road growth under the scenario of growth in accordance with the NBSP.

12.8 Construction Impacts

Construction of the link road would entail some short term impacts including reduced traffic speeds and increased travel times. The Central Option will require upgrading of one intersection on Illaroo Road, while the Northern and Southern Options will also require significant intersection improvement works on the Princes Highway. The existing Princes Highway/Narang Road intersection is the eastern connection point for the Central Option and no upgrading will be required. This will minimise disruption to Princes Highway traffic during construction.

All options require construction under traffic at Illaroo Road.

Major intersection works on the Moss Vale Road (at Elvin Drive) or on the Princes Highway (at West Bunberra Street) would produce significant impacts and delays associated with the construction of Northern and Southern Options.

12.9 Comparison of Options

Table 12.8 shows a comparative ranking of each of the route options against the 8 key traffic parameters that reflect the efficiency of the overall network. The rankings have been obtained by combining the AM and PM peak hour traffic analysis results to arrive at an overall rank. In most cases this was simple since the same option was clearly the best option during both the AM and PM peak hours. However, where there was a different ranking order between the AM and PM then ranking during both the AM and PM peak hour was carried out and the ranks integrated by adding the scores.

The total scores provided in the table are the sum of the ranking score for each parameter, and a lower score is the best result, showing that an option has ranked well across the most parameters.

The Table shows that both the Central and Southern Options deliver the best overall network improvements and for all intents and purposes are directly comparable when considering all parameters. The Northern Option is a poor performer when considering all parameters including the project objectives particularly when compared to the Central and Southern Options.

Generally the Southern Option has the least distances and times travelled and these metrics increase the further north the link road alignment is located (a finding consistent with Council's TRACKS analysis results). Whilst the Central route has slightly longer distances and overall network travel times compared with the Southern Option, the existing roundabout at the Princes Highway intersection with Narang Road (which would be retained for the Central Option) has better capacity to absorb traffic at the Highway end, compared with the new traffic signals that would otherwise be required for the Southern Option, and less direct impacts on existing collector roads in Bomaderry, leading to greater potential for traffic diversions to the Central Option in peak periods. This explains why the Central Option is a strong performer, showing a similar level of performance across all parameters when compared to the Southern Option.

The three shaded rows in the Table are considered to best reflect the project objectives being:

- Overall network efficiency measures as VHT.
- Number of vehicles on Link Road.
- South-bound travel times (i.e. out-bound traffic from North Nowra) during the AM peak period.
- Level of Service at the Illaroo Road/Princes Highway Intersection.

When these limited range of parameters are considered, the Central Option is the most beneficial, however this is a close result with the Southern Option. The Northern Option again performs poorly against these project objective parameters.

Table 12-8: Summary of Key Traffic Indicators for Comparison of Options

Parameter AM Peak Modelling	Central Route Option	Southern Route Option	Northern Route Option
VHT	2	1	3
Mean Speed	1	1	3
No. of Vehicles on Link Road	1	2	3
Travel Times – Route 1 (north bound) PM Peak	2	1	3
Travel Times – Route 2 (south bound) AM Peak	1	2	3
LoS – Illaroo Road/ Princes Highway Intersection (LOS and Average Delay)	2	1	3
LoS – Bolong Road/ Princes Highway Intersection (LOS and Average Delay)	3	1	3
Construction Impacts	1	3	3
Total Score	**13**	**12**	**24**
Score Against Project Objectives Parameters	**6**	**6**	**12**

Note: The lowest score is the best performing route option.

Based on the above analysis of the traffic assessment of the three North Nowra Link Road route options, it is clear that the Southern and Central Options provide a network improvement which best meet the project objectives (which are traffic related) and are most beneficial to the local transport network.

The Northern Option is the least beneficial route option, ranking worst in 7 out of 8 parameters and ranking worst in all of the traffic network parameters which represent the project objectives.

12.10 Management and Mitigation of Impacts

12.10.1 Operational Issues

The modelling shows that the North Nowra Link Road will result in marginal deterioration on the Bolong Road/Princes Highway intersection. The modelling shows that the construction of the Moss Vale Link Road and the implementation of the RCR improvements will offset these predicted impacts.

Council will continue to investigate the RCR network improvements in conjunction with the RTA, and will continue to plan for the construction of the Moss Vale Link Road as proposed under the NBSP.

Additional network connections between North Nowra and the Western Bypass Corridor are also likely to be necessary to limit future traffic from North Nowra congesting Illaroo Road, Moss Vale Road and the Princes Highway. This will be in addition to major Princes Highway capacity improvements in the medium to longer term.

12.10.2 Construction Issues

Further assessment would be carried out to identify construction related issues. Such issues could include:

- Impacts to road users on Illaroo Road (all options)
- Impacts to access arrangements for adjacent private properties (Options 2 and 3).
- Impacts to road users on the Princes Highway (Options 2 and 3)

Management measures that would be put in place during the construction of the proposed road include traffic management plans and the limiting of construction hours. Access to the majority of the construction zone will be limited to construction vehicles and plant. Where access is required to local residents and businesses, liaison and project delivery will be organised to minimize inconvenience and ensure ongoing access. Traffic management plans will be prepared and enforced where road works occur.

13.0 Biodiversity

The following section summarises the key outcomes of the Biodiversity Assessment carried out by Eco Logical Australia and which is provided in **Appendix F**.

Plans showing the location of vegetation and biodiversity constraints for each of the three route options are provided in **Appendix C**.

13.1 Vegetation Clearing

The proposed NNLR will generally be contained within a 30 m wide road reserve corridor, which would require a minimum cleared area of 21 metres under the AUSTROADS standards for new roads, based on the likely operational speed environment of 80 km/hr. In addition to this some additional clearing will be required to account for curves along the alignment and other structures which must be located outside of the cleared zone. Accordingly, a nominal 25 m cleared area has therefore been adopted for the proposed 30 m wide road reserve corridor.

13.1.1 Option 1 Central Option

The Central Option will have a 30 metre wide road reserve corridor for most of its length. However, to avoid ecologically sensitive areas near the route (i.e. in the vicinity of threatened flora species), it is proposed that this will be reduced, where practicable, to a 20 metre wide road reserve and clearance area. The narrower 20 metre wide road reserve and clearance zone would be subject to detailed design development, which would take into account the AUSTROADS standards and likely operational speed environment.

The Central Option will result in the clearing of approximately 2.31 hectares of vegetation. Of that, 1.6 hectares is situated within the Bomaderry Creek Regional Park. The area of vegetation to be cleared for the Central route option includes the cleared zone for the transmission line.

The main vegetation communities that would be cleared for the Central Option are:

- Gorge complex - Coachwood Warm Temperate Rainforest (0.1 ha)
- Scribbly Gum – Bloodwood Woodland and Scribbly Gum – Casuarina Forrest/Woodland (1.16 ha)
- Grey Gum – Stringybark Forest/Woodland (0.96 ha)
- Kunzea Shrubland (0.09 ha)

13.1.2 Option 2 Southern Option

The southern option will result in the clearing of approximately 4.14 hectares of vegetation, of which 0.3 hectares is situated within the Bomaderry Creek Regional Park. The main vegetation communities that would be cleared for the Southern Option are:

- Gorge complex - Coachwood Warm Temperate Rainforest (0.25 ha)
- Scribbly Gum – Bloodwood Woodland and Scribbly Gum – Casuarina Forrest/Woodland (1.46 ha)
- Grey Gum – Stringybark Forest/Woodland (2.13 ha)
- Kunzea Shrubland (0.13 ha)
- Sandstone Sedgeland (0.17 ha)

13.1.3 Option 3 Northern Option

The northern option will result in the clearing of approximately 4.52 hectares of vegetation, of which 0.9 hectares is situated within the Bomaderry Creek Regional Park. The main vegetation communities that would be cleared for the Southern Option are:

- Gorge complex - Coachwood Warm Temperate Rainforest (0.07 ha)
- Scribbly Gum – Bloodwood Woodland and Scribbly Gum – Casuarina Forrest/Woodland (4.02 ha)
- Spotted Gum – Turpentine Tall Forrest (0.43 ha)

13.2 Impacts to Threatened Species

An assessment is provided below for each threatened species known or likely to occur in the study area, for each of the 3 route options.

13.2.1 Endangered Ecological Communities

The Southern Option for the North Nowra Link Road may contain Lowland Rainforest within the gorge at Bomaderry Creek. Small stands of rainforest in the lower gorge at Bomaderry Creek could qualify as Lowland Rainforest because of the presence of subtropical species and the high plant diversity. This area of rainforest only occurs along the southern route and if present may potentially be indirectly impacted by the construction of the bridge for the southern route.

The Northern and Central Options will not impact on any endangered ecological communities.

13.2.2 *Zieria baeuerlenii* (Bomaderry Zieria)

The presence of *Zieria baeuerlenii* was recorded adjacent to the proposed development footprint for the Central Option and within the immediate surrounds, although no specimen are recorded within the proposed road reserve. No specimens were identified in the vicinity of the Southern or Northern route options.

Direct Impacts to Individual Specimen
No individual *Zieria baeuerlenii* will be lost as a result of construction activities. In particular two plants were recorded in the initial 30 metre road corridor for the Central Option. The initial concept road design was in the vicinityof some specimen, however the road reserve geometry has since been modified to be as far from these individuals as practicable. These individuals are part of a cluster located about 13 metres north of the centreline of the Central Option, and are outside of the proposed road reserve.

Although the proposed Central Option road reserve passes close to two individual plants, the Central Option will be designed so as not result in direct mortality. Because the road corridor has been refined to avoid direct impacts and a range of mitigation measures will be implemented to avoid indirect impacts, it is not considered likely that any of the known specimens in and around the Central Option will be directly impacted.

Indirect Impacts to Individual Specimen
Construction activities for the Central Option will pass nearby two individual plants and particular attention will be given to the design and the construction of the road in this area. In particular, potential impacts associated with runoff and stormwater will be addressed through the development of an Erosion and Sediment Control Plan followed by a Soil and Water Management Plan. The potential for direct mortality of individual plants is low given the design of the road will not result in their removal.

Indirect impacts will be mitigated accordingly through a range of measures designed specifically to reduce the likelihood of impacts on the Bomaderry Zieria, such as fauna accessible fencing restraining human activity yet with strategically placed locked gates allowing NPWS and Rural Fire Service access for improved control.

Indirect Impacts – Shading
The boundary of the construction corridor for the Central Option is approximately 10 metres from the nearest individual *Zieria baeuerlenii* colony. Whilst the clearing of land required for construction will remove a number of trees that may provide shade for the nearby *Zieria baeuerlenii* colony, it is expected that impacts associated with the potential exposure to heat and sunlight would be minor given that the trees to be cleared are to the south of all of the known *Zieria baeuerlenii* records. Previous studies have recorded the species from within a few metres of the construction corridor for the Central Option. However, during a recent site visit undertaken by an Eco Logical Australia ecologist on 16 August 2010, the closest *Zieria baeuerlenii* colony was recorded approximately 10 metres away from the construction corridor. Whilst extensive ground work was not undertaken, the absence of the previously recorded plants suggests that they have either died since originally being recorded or that the GPS coordinates were inaccurate. In any event, a number of mitigation measure aimed at reducing potential impacts associated with shading and exposure will be implemented.

Indirect Impacts – Loss of Habitat
A reduction in available habitat for *Zieria baeuerlenii* varies depending on the route that is selected. The species is known to occur in areas of Grey Gum – Stringybark Forest/Woodland. The reduction in available habitat for the species would be approximately 0.96 hectares for the Central Option and 2.11 hectares for the southern route. A reduction in available habitat is not likely to result from the construction of the northern route given the absence of Grey Gum – Stringybark Forest/Woodland.

Indirect Impacts – Accessibility and Vandalism
The construction of the North Nowra Link Road also has the potential to create more accessibility to the reserve and in particular in proximity to several colonies of *Zieria baeuerlenii* should the Central Option be constructed. There has been an 'ever-increasing' problem with illegal dumping at the council owned land at Bomaderry Creek. It is likely that an increase in traffic as a result of the link road may dissuade people from dumping rubbish. This would be due to the area being less isolated given an increase in regular traffic flow and increased surveillance meaning that perpetrators would have a higher likelihood of getting caught.

Although rubbish dumping activity, particularly of garden waste, in the location of the species has potential to have an adverse impact, unless the dumping of rubbish occurs directly in the vicinity of known specimens or their potential habitat, it is unlikely that impacts would occur. In the event that impacts on the species associated with dumping occur, the improved access to the site would allow the rubbish to be removed by Council and subsequent remedial action taken.

Trampling and vandalism is not considered a major impact on the species and it is considered unlikely that vehicles will stop along the North Nowra Link Road and increase the current passive use of the reserve for activities such as walking. The colonies of *Zieria baeuerlenii* close to the proposed Central Option have been the subject of previous vandalism and it is not expected construction of the North Nowra Link Road would increase the incidences of vandalism in the area. The vandalism is understood not to have been directed specifically at the Zieria Bomaderry plants, however, fencing is proposed to be erected to minimise the potential for vandalism, dumping and any potentially detrimental effect.

Indirect Impacts – Fragmentation and Barriers to Reproduction
Reproduction appears to be exclusively by vegetative spread and there is virtually no pollen viability and seed production. Due to this vegetative reproduction, disturbance to the movement of pollinators and seed dispersal vectors is not considered important. While the presence of the proposed road may present a physical barrier to a species which reproduces vegetatively, there is currently a permanently maintained service road along the line of the proposed Central Option, so any barrier a road represents is already permanently in place.

The issue of fragmentation for this species is unlike the majority of species. As *Zieria baeuerlenii* does not reproduce sexually nor produce seed, the movement of pollinators and seed dispersal vectors is therefore not important. Fragmentation of colonies of individuals is unlikely to impact on long-term survival as the species reproduces vegetatively with no associated risk, nor increased risk, of inbreeding depression.

The major concern in relation to fragmentation for this species is the splitting of colonies of individuals which belong to the same genotype. Twenty separate genotypes have been identified and mapped for the species, with each of these genotypes having been propagated at the Booderee Botanic Gardens. Given that there are 20 distinct clones present, it suggests that the species previously reproduced sexually, and may have since become inbred and sterile.

The current proposal does not split any genotypes nor isolate individuals from the rest of their genotype. The Central Option traverses close to only one genotype (Gn1) which will be the focus of increased conservation and mitigation efforts.

Indirect Impacts – Mitigation
A range of measures have been developed and committed to by Council to mitigate potential impacts on the species as a result of the construction of the Central Option, including:

- Plants nearby to the central road corridor (Gn1) will be permanently fenced in the vicinity of the road.
- Where possible, large trees that provide shade for Zieria along the Central Option will be retained.
- Compensatory planting of shade trees near the Central Option corridor.
- Minimal stopping areas will be provided along the road and reinforced through the use of fauna permeable fencing along the roadside to reduce the potential risk of fire from arsonists.
- During the construction of the road any nearby plants will be fenced prior to construction and clearly marked as “no-go” areas. Additionally, Council will ensure best practice field operations are aligned to the EMP ensuring acute awareness of all persons involved with the construction of the road.
- Road verge management will be undertaken in such a way as to maintain low fuel loads to reduce the risks of incidental fires.
- Weed management measure to reduce edge effects, including the control of runoff that may contain weed seeds and the washing down of vehicles to prevent the spread of weeds between areas, specific arrangements will be detailed in the EMP.
- Erosion and sedimentation control measures to ensure that surface runoff is directed to appropriately engineered discharge points so soil erosion is minimised. Soft engineering techniques will be included to protect drainage channels and to dissipate stormwater flows without causing erosion that could otherwise impact on the *Zieria baeuerlenii* individuals and other threatened plant species.

- Detailed stormwater design would ensure both surface and subsurface water flows do not have a detrimental impact on flora, in particular the *Zieria baeuerlenii*.
- An Erosion and Sediment Control Plan followed by a Soil and Water Management Plan will be prepared and implemented, and will include rehabilitation, sedimentation ponds, erosion controls where surface runoff is concentrated and other conventional measures for water sensitive design.

Council will consider the possibility of a funding contribution to DECCW for the ongoing management and conservation of this species. This funding could be used for:

- weed management within the habitat for the species, particularly for Bryophyllum and Lantana camara; and
- introduction of individuals into suitable areas either in the Bomaderry Creek area or elsewhere from propagated individuals kept at Booderee Botanical Gardens.

With the application of the proposed mitigation measures, it is not considered likely that the proposal will adversely affect long-term viability of the population.

13.2.3 *Eucalyptus langleyi* (Albatross Mallee)

An initial avoidance strategy for this species was used for the design of the proposed road, resulting in the avoidance of the majority of individuals within the vicinity of the route option footprints.

No individuals will be impacted either directly or indirectly by the Northern or Southern route options.

The presence of two individual *Eucalyptus langleyi* within the proposed development footprint for the Central Option indicates that there will be indirect impacts to this species. The potential loss of two individuals due to the construction of the Central Option is not considered likely to result in adverse impacts on this species, because of the thousands of specimen of this species in the region.

Although the two individuals that may be impacted by the Central Option are within the endangered population, all of the remaining individuals will remain in situ and will not be impacted either directly or indirectly by the construction of the North Nowra Link Road. Given that there will be a relatively small impact footprint from the proposed activities, and the size of other remnant vegetation stands in the area it is not considered likely that the impacts to two individuals would place the endangered population at risk of extinction, as it is unlikely to adversely affect the life cycle of this species or affect the ability of the remaining specimen to reproduce. The inclusion of the remaining individuals into the Bomaderry Creek Regional Park, as is proposed, will also greatly enhance the long term conservation of the population.

Mitigation measures aimed at minimising the potential for indirect impacts associated with the construction of the Central Option include:

- The species will be provided with increased habitat under DECCW tenure and management as a result of the proposed dedication of offsets land.
- Mitigation measures that aim to reduce impacts on *Zieria baeuerlenii* such as minimising stopping opportunities along the road, fencing the road and weed management activities will all serve to increase the security for *Eucalyptus langleyi* as well.

13.2.4 *Genoplesium bauera* (Bauers Midge Orchid)

Of the 23 identified individuals, 14 (from 7 clusters) are in the vicinity of the Central Option and 1 specimen may potentially be impacted due to clearing associated with the construction of the Central Option.

An additional 9 specimen (from 5 clusters) may potentially be impacted by clearing activities associated with construction the southern route. These individuals were recorded by an Australian Native Orchid Society Conservation Officer in April 2010.

Given that only a small number of individual specimens may potentially be indirectly impacted by the construction of the central or southern route, and the species is known to occur more broadly throughout the Shoalhaven region, adverse impacts on the species are not considered likely.

Any potential for indirect impacts, should the Central or Southern route options proceed, will be mitigated. Although no mitigation measures have been developed specifically for the species, the range of mitigation measure proposed for *Zieria baeuerlenii* such as fencing and limited stopping areas will also increase security for the species.

13.2.5 Hibbertia sp. Nov. 'Menai'

Of the 45 plants that closely resemble this yet undescribed taxon within the study area, 23 individuals occur on the southern route and 11 individuals occur near the Central Option. No Hibbertia were recorded within the construction footprint for the northern route option.

Considering the relatively small amount of vegetation loss due to the proposal, the large number of specimen in the region, and large amount of suitable habitat in the area, it is not considered likely that the proposal will have an adverse impact on the overall survival or general presence of this species.

No specific mitigation measures have been develop, however, the range of mitigation measures that will be implemented to mitigate impacts on *Zieria baeuerlenii* will also help reduce the potential for further impacts on individual Hibbertia specimens.

13.2.6 Gang-Gang Cockatoo

Both the central and southern routes have trees that would be suitable for nesting in the vicinity of their construction footprints. However, the breeding season for the Gang-gang Cockatoo extends from October to January and given that the species is only likely to be a visitor to the area during the winter months, it is not likely that the species is using the site for breeding. Further, potential nesting trees will not be directly impacted by the construction activities for any of the three route options.

The clearing of potential foraging habitat along all three route corridors is not likely to adversely impact the Gang-gang Cockatoo. The species is known to range widely throughout the region and the potential habitat areas that will be cleared as a result of construction activities only represents a small part of the overall foraging habitat that is available throughout the region.

13.2.7 Glossy Black Cockatoo

The main concentration of hollow-bearing trees and feed trees are situated along the northern and Central Option corridors. It is anticipate that approximately 0.01 hectares of habitat would be cleared for the construction of the northern route and approximately 0.175 hectares for the construction of the Central Option.

No habitat suitable for the species is likely to be cleared for the construction of the southern route option.

The amount of foraging and nesting habitat that is likely to be removed for the northern or central options only represents a small part of the habitat within the Shoalhaven region. As such, it is not considered likely that the construction of any of the potential route options would result in adverse impacts for the Glossy Black-Cockatoo.

13.2.8 Masked Owl

Whilst road-kill is considered a threat to this species, the threat is not considered as significant as the loss of hollow bearing trees and clearing of habitat. Eco Logical Australia assessed the threat of road-kill on this species as a result of the North Nowra Link Road to be low.

The Proposed mitigation measures include specific strategies that are to be implemented to reduce direct and indirect impacts on the Masked Owl including the potential for road-kill. Most notably these mitigation measures include road signage to warn of threatened wildlife in the area, speed limit reductions and light coloured road surface increasing the visibility of fauna at night.

Given that the species has a large foraging territory and home range and that only a small amount of habitat suitable for the species would be impacted by clearing for any of the three route options, adverse impacts on the species are not considered likely.

13.2.9 Square Tailed Kite

The habitat in the study area for this species is part of a very large foraging area for the species, covering thousands of hectares. As such, the clearing of vegetation associated with all three route options for the North Nowra Link Road is not expected to have an adverse impact on the Square-tailed Kite.

13.2.10 Powerful Owl

Potential nesting trees are almost certainly restricted to the gorge area. Vegetation required to be cleared for the three route options only represents a small part of the suitable habitat available throughout the broader region. The Powerful Owl has a large home range (c.450 to 1,000 hectares) and as such, the construction of the North Nowra Link Road is not considered likely to have an adverse impact on the species, regardless of the route option that is selected.

13.2.11 Sooty Owl

The Sooty Owl was recorded in the south of study area during field surveys and is likely to be an infrequent visitor to the study area and the Bomaderry Creek in general. Given that the species has a large foraging territory and home range and that only a small amount of habitat suitable for the species would be impacted by clearing for any of the three route options, adverse impacts on the species are unlikely as a result of the construction and operation of the North Nowra Link Road.

13.2.12 Scarlet Robin

Habitat suitable for this species is known to occur throughout the Shoalhaven region and the small area of potential habitat that exists within the study area only represents a very small portion of the overall habitat availability in the broader region. As such, the clearing of vegetation associated with all three route options for the North Nowra Link Road is not expected to have an adverse impact on the Scarlet Robin.

13.2.13 Flame Robin

Habitat suitable for this species is known to occur throughout the Shoalhaven region and the small area of potential habitat that exists within the study area only represents a very small portion of the overall habitat availability within the broader region. As such, the clearing of vegetation associated with all three route options for the North Nowra Link Road is not expected to have an adverse impact on the Flame Robin.

13.2.14 Little Lorikeet

Habitat suitable for this species is known to occur throughout the Shoalhaven region and the area of potential habitat that exists within the study area only represents a small portion of the overall habitat availability within the broader region. As such, the clearing of vegetation associated with all three route options for the North Nowra Link Road is not expected to have an adverse impact on the Little Lorikeet.

13.2.15 Varied Sittella

Habitat suitable for this species is known to occur throughout the Shoalhaven region and the small area of potential habitat that exists within the study area only represents a small portion of the overall habitat availability within the broader region. As such, the clearing of vegetation associated with all three route options for the North Nowra Link Road is not expected to have an adverse impact on the Varied Sittella.

13.2.16 Giant Burrowing Frog

There are no confirmed records of the Giant Burrowing Frog (GBF) being present in the study area. However, suitable sub-optimal breeding habitat (known as sandstone sedge) occurs within Bomaderry Creek Regional Park and lies adjacent to the northern edge of the Central Option. This primarily wet habitat is relatively small in size compared to other habitats in the Shoalhaven region and appears to be rarely inundated with water, which is required for the breeding process. Furthermore, most records for the GBF across the region occur in dry sclerophyll forest type habitats.

The Central Option, including the construction of the bridge, will remove a small amount of this sub-optimal breeding habitat, approximately 0.22 hectares.

Mitigating factors in relation to the potential impacts to the GBF resulting from the loss of potential habitat are:

- Potential breeding habitat exists only on the northern side of the Central Option eliminating the need to traverse the road to access additional area of habitat.
- The design of the bridge will allow non-impeded movement for terrestrial and aquatic species.

To mitigate the potential impacts on GBF and/or its habitat during the construction of the Central Option, mitigation measures that will be implemented include:

- Environmental Management Plan: EMP will be implemented during and post construction to limit direct and indirect impacts from the proposal on this species. This plan will guide the construction process and on-ground crew to limit impacts during and post construction.

- Weed invasion / edge effects: Stringent weed management measures will be implemented during and post construction to ensure indirect impacts (weed invasion and edge effects) does not impact on surrounding habitat. This will include the control of runoff that might contain seeds and the washing down of vehicles to prevent the spread of weeds between areas, rehabilitation of vegetation in areas of exposed ground using local native species.
- Runoff, sedimentation and erosion: Stormwater controls and the control of sedimentation and erosion will be documented through an Erosion and Sediment Control Plan followed by a Soil and Water Management Plan. The measures will channel water away from suitable habitat and may include the installation of silt traps, landscape contouring and alteration of the gradient and landform. These measures will be implemented to protect the suitable GBF habitat along the Bomaderry Creek and underneath and adjacent to the road (including bridge) by limiting and controlling the potential runoff from construction works.

Given the mitigation measures to be implemented during and post construction and the fact that no individuals have been recorded in the study area it is highly unlikely that the proposal will impact on the ability of this species (if present) to move between areas of suitable habitat or to continue using the small patches of remaining sub-optimal habitat.

The proposed mitigation measures will alleviate potential direct and indirect impacts to this species should it occur near any of the route options, which is unlikely.

13.2.17 Large-footed Myotis

All three route options will cross the gorge containing potential habitat for the species. However, suitable habitat areas are generally located at the bottom of the gorge and bridge design will ensure that potential habitat areas are not impacted directly or indirectly by the construction of the North Nowra Link Road. All three route options are not considered likely to result in adverse impacts on the Large-footed Myotis.

13.2.18 Spotted-tailed Quoll

Due to the highly mobile nature of this species and the large home ranges, adverse impacts due to the clearing of a small amount of potential foraging habitat (for any of the three route options) are not considered likely.

Eco Logical Australia considers that the potential for road kill for the Spotted-tailed Quoll is relatively low given the range of mitigation measures that will be implemented. Most notably these mitigation measures include road signage to warn of threatened wildlife in the area, speed limit reductions, light coloured road surface and an elevated bridge design to provide free underpass access. The proposed mitigation measures combined with the fact that the species is considered unlikely to occur within the study area, the already fragmented nature of the habitat and it's dominantly urban surrounds, suggest that impacts are not likely.

Although direct impacts will not occur and indirect impacts are considered unlikely, the general fauna mitigation measures will be implemented to minimise the potential for indirect impacts. These mitigation measures were developed in consultation with the Queensland Government's Fauna Sensitive Road Design Manual which provides an outline of the preferred practices for mitigating impacts on fauna that are associated with the construction of roads.

The following mitigation measures will be implemented to minimise the potential for indirect impacts on the Spotted-tailed quoll, and its habitat, within the study area:

- Develop strategies within the road design that avoids habitat fragmentation, including:
    - The road will be designed to leave the ground for a considerable distance at either side of the Creek crossing. Bridge structures will generally be elevated where possible. This elevation provides free underpass access for species that rely upon the environment adjacent to Bomaderry Creek.
    - Overpasses in the form of rope bridges or gliding poles with take-off and landing points will be designed and constructed in consultation with experts and best practice.
- Speed limit reduced to 60km/hr for the eastern end of the road near the Creek crossing to reduce potential fauna collisions.
- Light coloured road surfaces to enable contrast of fauna in headlights at night.
- Dense pavement material used to mitigate noise impact.
- Bridge design will acknowledge the objectives of the Bomaderry Creek classification as a Category 1 Environmental Corridor. It will be necessary for part of the bridge foundations to be located within the environmental corridor with a neutral effect following careful construction. The objective would be to maintain movement of terrestrial and aquatic species.
- Pre-clearing surveys to check tree hollows for threatened fauna species.
- Clearing supervised by a qualified ecologist to ensure minimal impact, rescue/move displaced/injured fauna.
- Timing of clearing/excavation to avoid high rainfall periods (increased erosion risk etc) & high bushfire risk periods.
- Clearing/construction methods to ensure no adverse impacts to adjacent habitats.
- Induction for construction workers regarding surrounding conservation values of the Bomaderry Creek Regional Park.
- Road signage to warn of wildlife crossing.

13.2.19 Grey-headed Flying-fox

The previously documented location of this species occurs at the south-eastern corner of the study area, approximately 1km from the construction footprint for the southern route corridor. Because of the distance, direct impacts on the species are not considered likely.

However, there is potential for indirect impacts to occur during the construction phase, in particular through increased noise during the breeding season.

The species has not been recorded at any other locations within the study area. Both the Northern and Central Options are not expected to impact on the Grey-headed Flying-fox or on important habitat areas for the species.

Whilst the species may use the habitat within these areas for foraging, the amount of land that is required to be cleared only represents a very small proportion of the overall foraging habitat in the region. The construction of either the central or northern route is not expected to result in adverse impacts on the Grey-headed Flying-fox.

Although direct impacts will not occur and indirect impacts are considered unlikely, the general fauna mitigation measures will be implemented to minimise the potential for indirect impacts. These are the same as would be applied for the Spotted-tailed quoll and are described in Section 13.2.18.

13.2.20 Yellow-bellied Glider

Mapping of feed trees for this species found that the northern and central corridors are not likely to impact on feed trees. However, the southern option has potential to require the clearing of possible feed trees which may result in indirect impacts on the species.

Although the southern route option is likely to indirectly impact on the use of feed trees and potential denning trees, there is sufficient habitat within the study area containing suitable feed trees and denning sites (hollow bearing trees) that will not be impacted by construction of the link road.

Taking into account the size of the home range (20-ha) and the ability of the species to move large distances, the resulting indirect impacts are likely to be minor.

The Northern and Central Options would not impact on feed trees for the species and adverse impacts associated with the construction of these route options are not considered likely.

The construction of the road (for all three options) has the potential to increase fragmentation effects. This combined with moving vehicles has the potential to reduce the movement of this species across Bomaderry Regional Park from the bushland on one side of the road to the other. Despite the ability of the gliders to be able to traverse the 30m from the bushland on one side of the road reserve to the other, the frequency and ability to glide may be reduced because the movement of cars and cleared nature of the road reserve.

To mitigate against the potential fragmentation impacts mentioned above, Shoalhaven City Council will provide overpasses for arboreal species in the form of rope bridges or gliding poles (designed and constructed in consultation with experts during the detailed design phase). Similar glider poles and rope bridges have been proven to be successful elsewhere. Other mitigation practices are the same as would be applied for the Spotted-tailed quoll and are described in Section 13.2.18.

13.2.21 Eastern Pygmy-Possum

Suitable habitat for the Eastern Pygmy Possum is known to occur throughout the Shoalhaven region and the area of suitable habitat that exists within the study area only represents a small portion of the overall habitat availability within the broader region. As such, the clearing of vegetation associated with all three route options for the North Nowra Link Road is not expected to have an adverse impact on the Eastern Pygmy-possum. However, in order to conclusively determine the likely presence of the species within the study area, SCC will undertake targeted surveys in early 2011

13.3 Mitigation Measures

To ensure that impacts are minimal a range of mitigation measures specific to each species have been developed. Mitigation measures, where proposed, for each threatened species are described above in the impact assessment for each species.

13.3.1 Flora Mitigation Measures

In particular, there is a range of mitigation measures proposed to avoid the potential impacts of the Central Option on *Zieria baeuerlenii*. These measures would also ensure that minimal impacts resulted in regards to other threatened flora species.

13.3.2 Fauna Mitigation Measures

Fauna mitigation measures are typical of similar projects and have been designed with the environmentally sensitive area of Bomaderry Creek Regional Park in mind. The rope bridges, glider poles and elevated bridge structures minimise potential fragmentation and allow movement of threatened species between habitats on either sides of the road. Wildlife crossing signs, reduced speed limits and lighter coloured road surfaces will ensure motorists are aware of potential threatened fauna in the area and allow greater vision at night to prevent collisions.

Details of mitigation measures to address edge effects and fragmentation of vegetation and habitat are described below.

13.3.3 Fragmentation of Fauna Habitat

In relation to the Central Option, the widening of the road from an infrequently used cleared service track to a single lane, two way road with a road reserve corridor of 30 metres (potentially 20 metres in areas of ecological significance) may have an impact on threatened fauna. Potential impacts associated with the development of the road include:

- increased fragmentation through the loss and degradation of vegetation and fauna habitat; and
- direct mortality of wildlife due to collision with vehicles.

To reduce the potential for impacts associated with fragmentation of the Bomaderry Creek Regional Park, measure such as maintaining overhanging trees and building fauna bridges and glider poles will be implemented. Specific detail in relation to these measures will be developed in the EMP. Overhanging trees will only be maintained where it is clear that they will not compromise road safety and/or become incompatible with the existing powerlines. The practicality of maintaining these trees will be fully assessed in the EMP.

The implementation of mitigation measures such as rope bridges and glider poles will help alleviate these two direct impacts. The use of fauna bridges is a proven and effective mitigation measure aimed at reducing fragmentation impacts. Building habitat connections like fauna bridges across roads or similar linear infrastructure may help maintain healthy and genetically diverse native animal populations by reducing the fragmentation and connectivity impacts generally associated with this type of infrastructure. The construction of a fauna bridge as a component of the North Nowra Link Road would be specifically targeted at reducing potential fragmentation and connectivity impacts on the Yellow-bellied Glider and other native species such as possums.

The Northern and Southern Options would require clearing from the north-western corner of the park and the south-eastern corner of the park respectively. This would not cause fragmentation to the Regional Park, and would not increase the number of edges for the Park, however where habitat was to be fragmented then fauna crossings would be included into the design.

13.3.4 Compensatory Offsets

In addition to the mitigation measures described above, Council also proposes to dedicate Council land to DECCW for inclusion into the Bomaderry Creek Regional Park as compensation for the revocation of land within the Regional Park for the North Nowra Link Road. Up to 50 ha of Council land has been assessed and could be dedicated for inclusion into the Regional Park. The proposed offset is described further in **Appendix F**. The transfer of this land will increase potential habitat for all fauna species within the Regional Park.

13.4 Comparison of Options

13.4.1 Central option

Four threatened flora species were recorded within the construction footprint for the Central Option:

- Two individual *Eucalyptus langleyi* (Albatross Mallee) may potentially be impacted by the construction of the bridge for the Central Option, although, adverse impacts on the species are not considered likely as these individuals only represent a small part of the overall population within the region.
- It was found that one individual *Genoplesium bauera* (Bauer's Midge Orchid) may potentially be indirectly impacted by the construction of the Central Option. However, it is not expected that this will result in adverse impacts on the species.
- Eleven individual *Hibbertia sp. Nov. 'Menai'* were recorded within or near the construction footprint for the Central Option. Although 9 of these individuals are expected to be directly impacted by the proposal, adverse impacts are not considered likely given the species abundance in the region.
- Two individual *Zieria baeuerlenii* were recorded in the initial 30 metre road corridor within the 200 metre wide assessment corridor for the Central Option. The road corridor was originally 30 metres wide commensurate with the standard design requirements for a sub arterial road. However, the road has been designed to a reduced width of 20 metres to avoid these individuals and a range of mitigation measures will be implemented to ensure no direct impact occurs. It is not considered that the Central Option would result in a significant new barrier to reproduction for *Zieria baeuerlenii* because there is currently a permanently maintained service road along the line of the proposed Central Option which is already a permanent barrier to vegetative reproduction.

Habitat for a number of threatened fauna species was recorded within the Central Option route corridor. In particular:

- Habitat suitable for the Giant Burrowing Frog (GBF) was recorded on the northern side of the Central Option, although no individual GBF have been recorded.
- Habitat for the Glossy black-Cockatoo, Gang-gang Cockatoo, Square-tailed Kite, Masked Owl, Powerful Owl, Large-footed Myotis, Yellow-bellied Glider and Spotted-tailed Quoll would be impacted, however, the amount of suitable habitat for these species that would be impacted only represents a small part of the overall habitat availability within the broader region.

13.4.2 Southern Option

Two threatened flora species are likely to be impacted by the construction of the southern route option:

- Twenty-three individual *Hibbertia sp. nov. 'Menai'* specimens are likely to be directly impacted by the construction of the southern route option. However, given the species abundance in the region, adverse impacts affecting the vulnerability of the species are not considered likely.
- Nine individual Bauer's Midge Orchid may potentially be impacted by the construction of the southern route option.

One threatened ecological community, the Lowland Rainforest of the NSW Coast and Sydney Bioregion, has potential to occur within the southern part of the gorge at Bomaderry Creek. There is potential for indirect impacts to occur as a result of the construction of the bridge for the southern option.

One threatened fauna species, the Grey-headed Flying-fox, was recorded within the vicinity of the southern route option. A potential flying-fox camp was recorded in the south-eastern corner of the study area and there is potential for indirect impacts to occur as a result of construction activities associated with the southern route option.

Habitat for a number of threatened fauna species was recorded within the Central Option route corridor. In particular:

- The southern route option was found to contain potential feed trees for the Yellow-bellied Glider.
- Habitat for a range of other threatened fauna species was also recorded, including; the Gang-gang Cockatoo, Square-tailed Kite, Masked Owl, Powerful Owl, Large-footed Myotis and Spotted-tailed Quoll would be impacted, however, the amount of suitable habitat for these species that would be impacted only represents a small part of the overall habitat availability within the broader region.

13.4.3 Northern option

The northern route option was found to contain potential suitable habitat for a range of threatened fauna species, including; the Glossy Black-Cockatoo, Gang-gang Cockatoo, Square-tailed Kite, Masked Owl, Powerful Owl, Large-footed Myotis, Yellow-bellied Glider and Spotted-tailed Quoll.

However, the amount of suitable habitat for these species only represents a small part of the overall habitat availability within the broader region. As such, adverse impacts on these species as a result of construction of northern route option are not considered likely.

No threatened flora species were recorded within the construction corridor for the northern option.

13.4.4 Preferred Option for Biodiversity

The Biodiversity impacts associated with each of the three route options have been assessed and a preferred option has been identified in terms of its overall biodiversity outcomes.

Table 13.1 shows a comparative ranking of each of the route options against the 11 key biodiversity parameters that reflect the potential for impact on biodiversity.

The total scores provided in the table are the sum of the ranking score for each parameter, and a lower score is the best result, showing that an option has ranked well across the most parameters.

Table 13-1: Summary of Key Biodiversity Indicators for Comparison of Options (numbers in brackets are the ranking)

Biodiversity Parameter	Central Route Option	Southern Route Option	Northern Route Option
Amount of total clearing (ha)	2.31 ha (1)	4.14 ha (2)	4.52 ha (3)
Amount of clearing within the Bomaderry Creek Regional Park (ha)	1.6 ha (3)	0.3 ha (1)	0.9 ha (2)
Potential Impacts to EEC	N (1)	Y (3)	N (1)
No. of Individuals of *Hibbertia* directly Impacted	9 individuals (2)	23 individuals (3)	0 individuals (1)
No. of Individuals of *Eucalyptus langleyi* directly Impacted	2 individuals (3)	0 individuals (1)	0 individuals (1)
No. of Individuals of *Genoplesium baueri* directly Impacted	0 individuals (1)	9 individuals (3)	0 individuals (1)
Potential Indirect Impact to *Zieria baeuerlenii*	Y (3)	N (1)	N (1)
Potential Impact to Grey-headed flying foxes	N (1)	Y (3)	N (1)
Impact to potential GBF habitat (ha) [1]	0.22 ha (3)	0 ha (1)	0 ha (1)
Impact to feed trees for Glossy Black-cockatoo	Y (3)	N (1)	Y (3)
Impact to feed trees for Yellow-bellied glider	N (1)	Y (3)	N (1)
Total Score	**22**	**21**	**16**

Note: The lowest score is the best performing route option.

Note 1: This represents a worst case assessment since the habitat is unlikely to be used by any GBF specimen.

In terms of impacts upon a listed threatened species the Northern Option provides the best biodiversity outcome. This is due to the fact that no threatened flora species are present and that the threatened species habitat within the construction corridor only represents a small part of the overall habitat availability within the broader region. Both the Central and Southern Options will directly impact a number of threatened flora species.

Although the Northern Option provides the best biodiversity outcome when compared to the Central and Southern Options, environmental impacts associated with all three routes are considered to be low provided that the specified mitigation measures are implemented.

14.0 Noise

The following section summarises the key outcomes of the Noise Assessment which is part of the AECOM Report, provided in **Appendix E**.

14.1 Noise Assessment Criteria

Noise criteria have been determined in accordance with the NSW Government's *Environmental Criteria for Road Traffic Noise* (ECRTN), which takes into account the functionally category of the existing and proposed future roads as well as the surrounding land uses. The relevant criteria for the various surrounding roads and land uses are provided in **Table 14.1**. The ECRTN sets noise limits for new roads, existing roads and sensitive land uses (e.g. schools and active recreational areas).

Table 14-1: Project Specific Noise Criteria

Location	Criteria ($L_{Aeq\ 1\ hr}$)		Where Criteria are Already Exceeded
	Day	Night	
New Link Road	60	55	The direct impact from the new road should be designed so as not to increase existing noise by more than 0.5 dB(A)
Surrounding Collector Roads	60	55	The new road should be designed so as not to increase existing noise by more than 2 dB(A) on surrounding collector roads.
Active recreational Areas	55	-	The road should be designed so as not to increase existing road traffic noise by more than 0.5 dB(A) for new roads and 2 dB(A) for an existing road.

Noise criteria are dependent on whether existing road traffic noise will exceed the criteria established within the ERCRTN, and whether the road traffic noise will exceed the criteria under the 'do nothing' scenario. The relevant noise criteria will be 60 dB(A) for all locations where existing road traffic noise is below 60 dB(A) during the day time and below 55 dB(A) during the night time. Where target noise goals are exceeded for the 'Do Nothing" scenario then the noise limit applied is such that the increase should by no more than +0.5 dB(A) due to the noise from new road and +2 dB(A) due to traffic changes on the existing road network arising from the development.

14.2 Noise Assessment

A SoundPLAN noise model was developed by AECOM to predict the future level of road traffic noise, and the change in the level of road traffic noise as a result of the North Nowra Link Road itself and because of changes in traffic on the surrounding roads. Background noise monitoring was used to validate the model.

In consultation with DECCW it has been agreed that it would be unreasonable to require detailed noise impact assessments for each route option given the current state of design. However, a semi-quantitative assessment against the ECRTN criteria was requested for each route option with a view to identify the relative ability of each route option to satisfy, to the greatest extent practicable, the ECRTN criteria. DECCW further requested that where a need for conceptual mitigation is identified the feasibility and reasonableness of the measures, and the commitment of Council to implement the measures, be identified.

Table 14.2 provides the 2016 projected road traffic noise at key locations throughout the study area, and shows the direct impacts from the three route options, with reference to the ECRTN daytime noise criteria.

Table 14-2: Summary of Noise Assessment

Location or Intersection	Modelled $L_{Aeq\ 1\ hr}$ [1]				>0.5 dB(A) (for Noise from New Link Road) Noise Criteria Exceeded [2, 3]			>2dB(A) (for Noise from existing Roads) Noise Criteria Exceeded [2, 3]		
	2016 Do Nothing	Option 1 – Central Option	Option 2 – Southern Option	Option 3 – Northern Option	Option 1 – Central Option	Option 2 – Southern Option	Option 3 – Northern Option	Option 1 – Central Option	Option 2 – Southern Option	Option 3 – Northern Option
Byron Av	51 to 59	**53 to 62**	52 to 59	51 to 59	Y	-	-	-	-	-
Narang Rd	66 to 71	**69 to 71**	65 to 70	65 to 70	-	-	-	Y	N	N
Princes Hwy/Narang Rd	70 to 78	70 to 77	-	69 to 76	-	-	-	N	-	N
Princes Hwy/West Bunburra St	76 to 77	-	77 to 78	-	-	-	--	-	N	-
Upgraded Illaroo Road/Pitt St	57 to 71	60 to 73	-	-	-	-	-	N	-	-
New Illaroo Road intersection	66 to 69	-	69 to 72	-	-	Y	-	-	Y	-
West Cambewarra Rd/Illaroo Rd	66 to 67	-	-	67 to 68	-	-	-	-	-	N
Falcon Cr near Illaroo Rd	52 to 60	53 to 60	57 to 62	51 to 59	-	Y	-	-	Y	-
Sutherland Dr	52 to 53	52	**59 to 61**	51 to 52	-	-	-	-	Y	-
West Cambewarra Rd	50 to 55	51 to 55	50 to 55	**60 to 66**	-	-	-	-	-	Y
Moss Vale Rd (500m from Princes Highway)	58 to 69	58 to 69	58 to 70	59 to 70	-	-	-	N	N	N
Moss Vale Rd/Elvin Rd	58 to 62	58 to 62	58 to 63	59 to 64	-	-	-	N	N	N
Illaroo Rd Primary School	74	73	73	73	-	-	-	N	N	N
45 Illaroo Rd	75	74	75	74	-	-	-	N	N	N
Surrounding Road Network	50 to 78	51 to 78	50 to 78	50 to 77	-	-	-	N	N	N

Notes:

1. There is a range of modelled noise levels because there are a number of properties at each location potentially affected. Green shading means that the criteria are met at the specified location (i.e. predicted impacts would be acceptable). Red shading means that the criteria would be exceeded unless mitigation was implemented to mitigate adverse noise impacts to within acceptable levels.
2. The 0.5 dB(A) criterion is applicable where a location is adjacent to the proposed link road route option, and the 2 dB(A) criterion is applicable where a location is adjacent to an existing road.
3. The cells shown in grey are not relevant to be considered for the analysis. This can be because the location is not relevant for a particular link road route option (i.e. it is unaffected by the new Link Road either directly or indirectly), or the location is not relevant to the specified criteria.

While **Table 14.2** only assesses the three route options against the daytime ECRTN criteria, it provides a quantitative assessment of the residential locations where the ECRTN are projected to be exceeded, and therefore where conceptual mitigation is likely to be required in order to comply with the ECRTN criteria. The daytime period was identified as being the critical assessment period since it contains both the AM and PM peak periods.

The noise assessment was based on the worst case traffic volumes, as established through the AECOM traffic modelling. This included between 450 and 500 vehicles per hour the link road, approximately 1,400 vehicles per hour on the northern section of the Princes Highway, approximately 4,200 vehicles per hour on the southern section of the Princes Highway, approximately 550 vehicles per hour on the northern section of Illaroo Road and approximately 1,500 vehicles per hour on the southern section of Illaroo Road.

The table clearly shows that each of the 3 route options would result in potential exceedances of the ECRTN criteria at private residential properties. The following sections of this report discuss the relative significance of the impacts, and the type of mitigation that could be applied for each option.

It should be noted that the purpose of the noise assessment carried out to date has been primarily to determine the relative performance of route options based on road traffic noise impact. Additional noise modelling will necessarily be undertaken following finalisation of road layout and pavement heights to confirm the mitigation and treatment measures required. This modelling will take into consideration the shielding by buildings and structures.

14.2.1 Noise Assessment of Option 1: Central Option

Impacts to Residential Properties

Three properties on Byron Avenue have been identified as having road traffic noise levels exceeding the 60 dB(A) criterion and also having noise levels which exceed the acceptable level of increase (0.5 dB(A) for a new road) compared with the 2016 'do nothing' scenario. These properties are located immediately at the northwest corner of Byron Avenue (or the southeast corner of the upgraded intersection of Pitt Street, Illaroo Road and the Central Option), and are highlighted in pink in the figure entitled "Option 1 Facade noise levels - Impact from new roads (increase of 0.5 dB(A))" in Appendix K of the AECOM report.

The level of mitigation required to meet the noise criteria at Byron Avenue is in the order of 0.5 to 2 dB(A). This may be achieved with a 2 m high berm or noise barrier or a low noise road surface. However given that the level of noise mitigation required is relatively small this should be further investigated during the detailed design phase when the final road alignment and pavement elevation are known.

As shown in **Table 14.2,** for the other properties surrounding the upgraded Illaroo Road/Pitt Street intersection road traffic noise levels will exceed the 60 dB(A) criterion by up to 13 dB(A), however the level of increase will be within the 2 dB(A) increase specified for existing roads and so would be unlikely to warrant mitigation.

Noise impacts at locations on the surrounding roads are not predicted to be significant, in particular there are unlikely to be any changes to traffic noise levels for properties located at West Cambewarra Road, Falcon Crescent, Sutherland Drive, Moss Vale Road or the Princes Highway. There may be a slight reduction in noise level (relative to the year 2016 "Do Nothing" case) of less than 1 dB(A) near 45 Illaroo Road and Illaroo Road Primary School with the Link Road. However in practice a reduction of that order would be barely perceivable.

Impacts to the Bomaderry Creek Regional Park
Noise contours showing the 55 dB(A) recreational noise criterion caused by road traffic are provided in Appendix L of the AECOM report. The noise levels in some parts of the recreational areas in and around the Regional Park are predicted increase due to the Central Option. In total an area of approximately 57 ha within passive recreational areas are predicted to experience road traffic noise impacts which exceed the criterion. This 57 ha affected area includes:

- The part of the Regional Park along the Central Option which would be newly affected.
- The northwest corner of the Regional Park which is affected by existing road traffic noise along Illaroo Road (which will not change).
- Parkland located on the eastern side of the Regional Park, along the Gorge, as well as to the east of the Gorge, most of which is on Council owned land. Road traffic noise in these areas is dominated by the traffic noise from the Princes Highway which is not predicted to change.
- Council owned recreational land to the north of the Regional Park which would be newly affected.

One lookout point and one picnic area fall within the 55 dB(A) contour area in the vicinity of the Option 1 alignment, however the picnic area is approximately 50 m from the proposed route. Part of the Bomaderry Creek Walking Track and a very small part of Bernie's Walk are also located within the 55 dB(A) contour area.

Night Time Sleep Disturbance Impacts
There are 52 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by, although these properties are all located on the Princes Highway or Illaroo Road which would be currently affected by heavy vehicle drive by, and those arterial roads are the primary source of road traffic noise for residences. That is, those residences would be subjected to those noise levels irrespective of the NNLR Central Option.

14.2.2 Noise Assessment of Option 2: Southern Option

The Southern Option may impact on residences in the vicinity of:

- Falcon Crescent, Sutherland Drive, Warren Avenue, and Narrien Place;
- a new intersection at Illaroo Road; and
- at the upgraded intersection on Princes Highway at West Bunberra Street.

Impacts to Residential Properties – Falcon Crescent and Sutherland Drive
As can be seen from **Table 14.2**, road traffic noise levels are predicted to increase at Sutherland Drive (and so similarly at Warren Avenue and Narrien Place) by up to 8 dB(A), although the 60 dB(A) criteria may only be marginally exceeded at two individual properties (by up to 1 dB(A)).

Option 2 passes through the corner of Lot 118 DP 751258 (Por 118) Jamieson Road, which is the location of an approved sub-division (shown as a residential use in **Figure 11.2** immediately to the south of the former Council landfill site). Noise levels are expected to exceed the 60 dB(A) criteria within the subdivision area. During detailed design it would be investigated if the alignment of Option 2 could be adjusted so that it does not pass closer than 70 m from the nearest residential property boundary. This is to avoid the need for a noise wall or berm. A lesser setback could be considered with an appropriate noise wall or berm. The noise levels at Lot 118 DP 751258 (Por 118) Jamieson Road would be reviewed during detailed design once the final alignment and location of residences within the subdivision are known.

The road traffic noise levels on Falcon Crescent are shown in **Table 14.2** as exceeding the criteria, however there are no residential properties which would be impacted by these predicted increases in road traffic noise.

Impacts to Residential Properties – New Intersection and Illaroo Road
The noise levels, near the proposed new intersection at Illaroo Road, are already predicted to exceed the daytime ECRTN noise criteria of 60 dB(A) in 2016 by up to 9 dB(A). This restricts the maximum increase to 2 dB(A) due to changes in traffic on the existing road network and 0.5 dB(A) due to noise emission from the new road and intersection. At the location of the new Illaroo Road intersection:

- One property not impacted by existing road traffic noise (which is actually street addressed on Byron Avenue) is identified as experiencing road traffic noise level greater than 60 dB(A) and an increase of greater than 0.5 dB(A) (ECRTN criteria for new roads). However, this property is only marginally affected at the property edge, and it is unlikely that mitigation would be required.
- Option 2 would cause the high levels of road traffic noise experienced in 2016 (66-69 dB(A)) to increase on Illaroo Road in this location by up to 3 dB(A). It is estimated that 3 residential properties might exceed the 2 dB(A) criterion for noise increases on existing roads. Mitigation other than property treatments may be impractical at these locations.

Impacts to Residential Properties – Princes Highway
Table 14.2 shows that the predicted road traffic noise along the Princes Highway in 2016 will exceed the daytime ECRTN criterion by up to 17 dB(A), but that Option 2 would not increase the road traffic noise at this location by more than 2 dB(A). Notwithstanding this, the contours shown in figure entitled "Option 2 Facade noise levels - Impact from existing roads (increase of 2 dB(A))" in Appendix K of the AECOM report shows that some of the properties which front the Princes Highway in the location of its new intersection with Option 2 would be subject to exceedances of the criteria. While eight properties are identified on the figure as being so affected, at least three of these will need to be acquired to make way for the Southern Option, and so some five properties might require mitigation.

The increase in noise levels for receivers at the Princes Highway intersection may be reduced with a noise wall in the order of 2.5 m in height. This would need to be reviewed following confirmation of the final road layout and pavement levels. Subject to design, it is considered that the provision of noise wall would be effective in offsetting the adverse noise impacts of the Link Road Option 2 only on adjacent properties, and would not be effective in offsetting the predominant noise source – that is the adverse noise impacts associated with background traffic growth on Princes Highway itself. If this Southern Option is further investigated, the design of a noise wall in this location would need to take specific consideration of visual amenity issues for adjacent properties.

Impacts to Residential Properties – Surrounding Road Network
As with Option 1 the additional noise impacts at locations on the surrounding road network are not predicted to be significant. There may be a slight reduction in noise level (relative to the year 2016 "Do Nothing" case) of less than 1 dB(A) near 45 Illaroo Road and Illaroo Road Primary School with the Link Road (i.e. taking noise levels back to equivalent 2006 levels). However in practice a reduction of that order would be barely perceivable.

Impacts to Residential Properties – Summary
In summary, a total of 14 properties have been identified as having road traffic noise levels which are predicted to exceed the ECRTN daytime criterion of 60 dB(A) and also noise level increases which exceed the acceptable level of increase (0.5 dB(A) for a new road and 2 dB(A) for an existing road) compared with the 2016 'do nothing' scenario.

- Of these 14 residential properties three are affected by traffic noise from the new link road. However these three properties are predicted to only marginally exceed the daytime noise criteria of 60 dB(A) and further detailed noise modelling, to be carried out as part of further design, may identify that mitigation is not required. An approved subdivision is also affected.
- Of these 14 residential properties, 11 are located adjacent to existing roads, with three on Illaroo Road and eight on the Princes Highway. Of the eight properties on the Princes Highway at least three of these will need to be acquired to make way for the Southern Option, and so some five properties would be likely to require mitigation.
- As such, a total of eight properties are predicted to experience significant noise impacts because of this route (three on Illaroo Road and five on the Princes Highway).

Impacts to the Bomaderry Creek Regional Park
Noise contours showing the 55 dB(A) recreational noise criterion caused by road traffic are provided in Appendix L of the AECOM report. The noise levels in some parts of the recreational areas within and surrounding the Regional Park are predicted to increase due to the Southern Option. In total an area of approximately 60 ha within passive recreational areas are predicted to experience road traffic noise impacts which exceed the criterion. This 60 ha area that is affected includes:

- The part of the Regional Park along the route option which would be newly affected, but which are located in the southern and south-eastern boundary of the Regional Park, which are adjacent to the former landfill site, and where there are no walking tracks, picnic areas or lookouts.
- The northwest corner of the Regional Park which is affected by existing road traffic noise along Illaroo Road (which will not change).
- Parkland located on the eastern side of the Regional Park, along the Gorge, as well as to the east of the Gorge, most of which is on Council owned land. Road traffic noise in these areas is dominated by the traffic noise from the Princes Highway which is not predicted to change, however noise from the Southern Option would increase the amount of recreational land in this location affected by road traffic noise.

No picnic area, lookout point or walking track within the Regional Park fall within the 55 dB(A) contour. However, the Southern Option would cross the Bomaderry Creek Gorge where there is a Council maintained walking trail which connects to the walking trails within the Regional Park. The location of the new bridge for the Southern Route option would provide a new noise source into this part of the recreation area which would be perceived by walking trail users as a significant noise impact compared with the present situation or the 'Do Nothing' option.

Night Time Sleep Disturbance Impacts
There are 104 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by. These include newly affected residences on Falcon Crescent, Sutherland Drive, Warren Avenue, and Narrien Place, as well as residential properties and schools on Illaroo Road and the Princes Highway that would already be potentially affected irrespective of the Link Road.

14.2.3 Noise Assessment of Option 3: Northern Option

Impacts to Residential Properties

The noise assessment modelling was carried out on the alignment of the Northern Option along the existing alignment of West Cambewarra Road. The construction of the Northern Option along this alignment may cause noise criteria to be exceeded by up to 6 dB(A) at residences on West Cambewarra Road and Moss Vale Road.

A total of 27 residential properties have been identified as having road traffic noise levels exceeding the ECRTN daytime criterion of 60 dB(A) and also having noise levels which exceed the acceptable level of increase (0.5 dB(A) for a new road and 2 dB(A) for existing road) compared with the 2016 'do nothing' scenario, including:

- 19 residential properties located along West Cambewarra Road which currently experience road traffic noise well below the 60 dB(A) criterion, but are predicted to experience exceedances of up to 6 dB(A) above the daytime criterion because of the new link road.
- Eight residential properties located at the corner of Illaroo Road and Cambewarra Road, which are predicted to experience road traffic noise of up to 7 dB(A) above the daytime criterion, and which may experience noise increases of approximately 2 dB(A).

While it may be possible to construct noise walls that achieve 6 dB(A) of noise reduction it may not be feasible as these residences have access driveways to these roads. The access points would create gaps in the noise wall and significantly reduce the amount of noise reduction that may be obtained.

A noise reduction of up to 2 dB(A) may be achieved through a change in road surface type from Dense Graded Asphalt to Open Graded Asphalt; however this may not be sufficient reduction to meet the ECRTN noise goals. Another alternative would be to consider property treatments; however, these only reduce the internal noise levels and do not protect the amenity of outdoor areas.

To avoid installing noise mitigation measures (e.g. a noise wall or berm) Option 3 would need to be offset from the existing Cambewarra Road alignment by minimum of 70 m from nearest property boundary in order to ensure noise impacts fall within acceptable limits. The existing Cambewarra Road would be retained as service road with a single access point back to Link Road. This would require considerable encroachment into the adjacent Regional Park in the order of some 80 m. It is noted that the dedication of the adjacent lands as Regional Park made an allowance of only 10m encroachment into the Regional Park. This would not be sufficient to attenuate noise impacts, and would mean direct impact of the Link Road on existing residences.

The encroachment into the Regional Park could be reduced significantly if a berm or barrier was constructed between the Link Road and the existing West Cambewarra Road. The geometry of the road connection to West Cambewarra Road is likely to dictate the extent that the Northern Option would need to be offset from West Cambewarra Road, and the nature of the noise mitigation to be provided would be subject to the amount of residual land between the two roads. This aspect would be subject to more detailed engineering design and noise assessment if this route were to be further investigated, however a minimum setback of 50 m is proposed, and the Northern Option route alignment has been refined accordingly. Road traffic noise increases on Moss Vale Road and Elvin Road are predicted to be less than 2 dB(A), and the difference (increase or decrease) in noise levels at other locations on the surrounding road network are not predicted to be significant and barely perceivable compared with the year 2016 "Do Nothing" option.

Impacts to the Bomaderry Creek Regional Park
Noise contours showing the 55 dB(A) recreational noise criterion caused by road traffic are provided in Appendix L of the AECOM report. The noise levels in some parts of the recreational areas within and surrounding the Regional Park are predicted to increase due to the Northern Option. In total an area of approximately 53 ha within passive recreational areas are predicted to experience road traffic noise impacts which exceed the criterion. This 53 ha area that is affected includes:

- The northwest corner of the Regional Park which is currently affected by existing road traffic noise along Illaroo Road. The area affected in this location will be increased because of the increased road traffic noise from the Northern Option.
- Parkland located on the eastern side of the Regional Park, along the Gorge, as well as to the east of the Gorge, most of which is on Council owned land. Road traffic noise in these areas is dominated by the traffic noise from the Princes Highway which is not predicted to change.

However, no picnic area, lookout point or walking track within the Regional Park fall within the 55 dB(A) contour.

Night Time Sleep Disturbance Impacts
There are 43 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by. These include newly affected residences on West Cambewarra Road, as well residential properties on Illaroo Road and the Moss Vale Road that would already be potentially affected. This impact would also be addressed through the setback of the Northern Option road alignment and the provision of a noise barrier or berm between the new road and residents.

14.3 Management and Mitigation of Noise

14.3.1 Operational Noise

All three route options would require noise mitigation treatments to protect against traffic noise affecting residential amenity. This may include:

- Option 1: Central Option – A noise wall or berm, or low noise pavement, where the new Link Road is close to the residents on Byron Avenue.
- Option 2: Southern Option – A noise wall located near the intersection of the new Link Road with the Princes Highway and potentially noise treatments to individual residences. This would not, however address the predominant road traffic noise source affecting the relevant properties, which is the Princes Highway.
- Option 3: Northern Option – A noise wall or berm along the length of West Cambewarra Road, as well as offsetting the alignment to the south of the properties, encroaching into the Regional Park.

In all cases the details of the mitigation treatment (noise walls or berms) would be confirmed during the detailed design phase when the final road alignment and pavement elevation are known, and would be informed by further detailed noise modelling.

14.3.2 Construction Noise

Further assessment would be carried out to identify construction related noise issues. Management measures that would be put in place during the construction of the proposed road include construction noise management plans and the limiting of construction hours.

14.4 Comparison of Options

Table 14.3 shows a comparative ranking of each of the route options against 3 key noise parameters that reflect the relative impact on noise amenity. The table ranks the options with the lower ranking being the better performing option.

The total scores provided in the table are the sum of the ranking score for each parameter, and a lower score is the best result, showing that an option has ranked well across the most parameters.

The Central Option is the best route for protecting the noise amenity of existing residential properties with minor predicted exceedances of the criteria at a small number of residential properties. However, it would provide the greatest noise impact for walking trails in the vicinity of the Central Option and on the recreational facilities around the picnic area in the Bomaderry Creek Regional Park.

The Southern Option would result in potentially significant impacts to residents in the vicinity of Sutherland Drive, including at an approved subdivision, and would result in potentially twice the number of residents affected by sleep disturbance compared with Option 1. While it does not impact on recreational areas within the Regional Park, it would provide a new noise source for the Council managed walking trails adjacent to the Regional Park. As such, the Southern Option is clearly the worst performing route option in terms of potential noise impacts, with impacts to residential properties, the approved subdivision and recreational areas, with complex mitigation to be considered during subsequent design stages, especially in the location of the new intersection with the Princes Highway.

The Northern Option would result in potentially significant noise impacts along West Cambewarra Road and at the intersection with Illaroo Road, which could be difficult to mitigate, and would potentially require property treatment, as well as the off-set of the road into the Regional Park and the construction of a noise wall or berm. The Northern Option would not increase significantly any impacts to recreational areas within or around the Regional Park.

Table 14-3: Summary of Impacts to Private Properties and Recreational Areas for Comparison of Options

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Direct New Impact of the Link Road on Existing Private Residences	1	2	3
Direct Impact of the Link Road on Existing Private Residences already Affected by Traffic Noise	1	3	2
Impact on the Amenity of Recreational Areas not in BCRP	1	3	1
Impact on the Amenity of Recreational Areas in BCRP	3	1	1
Total Score	**6**	**9**	**7**

Note: The lowest score is the best performing route option.

15.0 Visual Impact

The visual impacts of each corridor option are detailed in the visual assessment study in **Appendix H**, which has been summarised below.

15.1 Visual Impact Assessment of the Central Option

From Illaroo Road the corridor follows a transmission line easement that is regularly cleared through the plateau vegetation. The landform is typically flat and gently falls away in an easterly direction to the top of the gorge which is dissected by Bomaderry Creek.

The gorge at the point of the proposed crossing is wide and deep with canopy and understorey vegetation on both sides amongst the rocky outcrops and boulders. There is a 600mm water pipe and a weir. Both these installations disturbed adjoining bushland, though there is little evidence of significant weed infiltration.

Across the gorge to the east the contours slope upward and patches of vegetation have been disturbed by recent fires, clearing and construction. New tubestock species have been planted near the corridor. There is a mix of mature Eucalypts and Casuarinas sparsely dominating an understorey of native species and weed. The landscape character of this area has been aesthetically degraded despite the recent planting.

The study identified the following key assessment outcomes for the central corridor in four contextual areas.

- The Pitt Street intersection: Clearing of vegetation at the Pitt Street intersection will not cause significant visual impacts because the existing services corridor has already resulted in a cleared corridor at this intersection.
- Views from existing residences: Outlooks from the rear of three properties in Byron Avenue will be significantly impacted due to the construction of the Central option. The implementation of noise mitigation measures is also likely to affect the outlooks from these properties
- Views from Bernie's Lookout trail: The Western Walk and the Eastern Walk will be adversely affected by the bridge crossing; and
- Views from the picnic area off Narang Road: The recreational experience and visual amenity of visitors to the Bomaderry Creek Regional Park picnic area and gorge walking trails would be moderately impacted at a localised level. The visual amenity of the picnic area and walking trails within the Bomaderry Creek Regional Park are already compromised to some degree by the presence of the existing water pipeline crossing Bomaderry Creek.

Mitigation opportunities for the central corridor include:

- A mounded and planted berm on the southern side of the western end of the route to minimise visual (and noise) impacts to the nearby residents on Byron Avenue.
- Revegetation of the land where the Central Route would cross the disused quarry.
- Relocation of Bernie's Lookout trail to develop alternative viewpoints from on and under the bridge.
- Mounding on both sides of the road reserve where it passes the picnic area in the Regional Park to protect the integrity of the visual amenity of the picnic area.

15.2 Visual Impact Assessment of the Southern Option

The remnant vegetation from the start point at Illaroo Road is a dry woodland forest, through which the Southern Option corridor passes as it travels along the plateau, before passing beside a disused and closed Council landfill site. In this area the landscape quality deteriorates as the vegetation and landscape character change dramatically to a cleared and modified environment.

Once passed the fence line of the former land fill site, the landform gently falls towards Bomaderry Creek gorge. Rocky outcrops occur throughout and the understorey alters from dense and prickly to sparse and shrubby. At the crossing point the gorge is wide and deep with rocky platforms edging the top of the escarpment to the base of the gorge. Vegetation is moderately closed, dense and undisturbed.

The study identified the following key assessment outcomes for the southern option in three contextual areas.

- New intersection with Illaroo Road: Localised clearing of bushland near the new intersection with Illaroo Road would not be visually significant because of the large amount of vegetation remaining.
- Clearing on Crown Land near Falcon Crescent: Road works clearing near Falcon Crescent would not be easily seen from nearby residences, so the localised impacts would be minimal.
- Bomaderry Creek Crossing: The bridge crossing of Bomaderry Creek would cause a substantive negative visual impact to the existing amenity of the Bomaderry Creek Gorge, including the existing walking trails which connect to the trails within the Bomaderry Creek Regional Park. However the site is remote and impacts would be localised.

Mitigation of the southern corridor would be confined to normal revegetation of disturbed areas and appropriate visual treatment of acoustic barriers, which may be required at both the eastern and western ends of the route option.

15.3 Visual Impact Assessment of the Northern Option

The vegetation is dense along the Northern Route Option and as the contours and aspect fall gently towards the east at Bomaderry Creek, the Eucalypts become taller and Turpentines occur. Small shrubby plants appear sparsely dotted between rocky boulders.

The Bomaderry Creek Gorge at the proposed crossing point is both narrow and much shallower than the two other proposed crossing points. On the other side of the creek the remnant vegetation is bordered by cleared fields and agricultural buildings.

The study identified the following key assessment outcomes for the northern option in four contextual areas.

- New intersection with Illaroo Road: Clearing at Illaroo Road would be required, though retention of vegetation inside the nature reserve would minimise these impacts.
- Walking trails connecting to West Cambewarra Road: There would be variable impact from the informal walking trails that connect to West Cambewarra Road.

- Bridge crossing: The proposed bridge crossing would be a key location causing moderate visual impacts to bushwalkers, but should be well shielded from nearby houses.
- Views from West Cambewarra Road residences: Views from residences will be affected by the barriers required for noise amelioration.

The northern option would have extensive acoustic berms (or barriers), and these would have the potential to impact on the visual amenity of West Cambewarra Road unless treated properly. As there would be a trade-off between the type of acoustic control and the level of encroachment into the Regional Park, further consultation with the community and DECCW would be needed during the design development to ensure an appropriate mitigation and landscape solution is adopted.

15.4 Comparison of Options

The visual amenity impacts of the route options in relation to amenity of the Bomaderry Creek Regional Park, the visual amenity of Bomaderry Creek Gorge, and the visual amenity to existing residential areas have been considered in Section 11 as part of consideration of impacts to surrounding residents , and other local land users, and impacts to amenity. To avoid double counting these impacts have not been re-scored.

All of the NNLR route options would result in potentially significant visual amenity impacts which would require the development of a landscaping and urban design strategy to manage. The strategy would be prepared as part of the detailed design.

16.0 Aboriginal Heritage

An Aboriginal archaeological assessment report was carried out by Kelleher Nightingale and is provided in **Appendix G.** An assessment of potential Aboriginal heritage and Archaeological impacts is provided below.

16.1 Aboriginal Heritage Assessment of the Central Option

16.1.1 Aboriginal Heritage Archaeology

The Central Option does not exhibit a direct impact on any significant archaeological features. However it will likely directly impact on 3 disturbed Aboriginal heritage sites of low archaeological significance, as shown in **Table 16.1**.

Table 16-1: Aboriginal Sites Directly Impacted by the Central Option

Report ID	AHIMS ID	Description of Potential Impact	Condition	Archaeological Significance
BCRP 006	52-5-0542	Potential Direct Impact	Poor	Low
BCRP 011	52-5-0390	Potential Direct Impact	Poor	Low
BCRP 012	52-5-0544	Potential Direct Impact	Poor	Low

Note: For a full list of Aboriginal heritage sites see **Section 6.3.7**.

No mitigation is warranted for the impacted sites associated with the Central Option. The sites are either disturbed or contain little potentially significant archaeological information (e.g. disturbed or no archaeological deposit). However it is recommended that any impact is avoided, if possible, in detailed design and construction planning. In particular, further detailed design may be able to avoid direct impact to site 52-5-0542. It is further recommended that any portions of a site not directly impacted should be temporarily fenced along the construction boundary to limit inadvertent impacts.

Archaeological sites in proximity to the Central Option may be indirectly impacted by future construction activities; in particular rock art sites are vulnerable to vibration. Site 52-5-0262 is located within 100m of the Central Option but does not contain rock art or a particularly vulnerable rock overhang. The closest rock art site is approximately 200m south of the Central Option. This distance should be sufficient to provide protection to the art.

16.1.2 Aboriginal Cultural Significance

Consultation with the local Aboriginal community identified that the archaeological sites potentially impacted by Option 1 were seen as representing low cultural significance and not warranting mitigation.

16.2 Aboriginal Heritage Assessment of the Northern Option

The Northern Option will directly impact on 2 Aboriginal heritage sites of moderate Aboriginal archaeological significance and 1 site of low archaeological signfiance, as shown in **Table 16.2**. The items of moderate Aboriginal archaeological significance are:

- BCRP 014: This site is located on the foot track that runs off the end of West Cambewarra Road to Bomaderry Creek, and contains more than 20 artefacts exposed in the sides of the erosion banks on the track. Some level of salvage excavation may be required prior to construction for this item.
- BCRP 028: 10 axe grinding grooves located adjacent to Bomaderry Creek. It is unlikely that it will be possible to mitigate the impacts to this site.

Table 16-2: Aboriginal Sites Directly Impacted by the Northern Option

Report ID	AHIMS ID	Description of Potential Impact	Condition	Archaeological Significance
BCRP 014	52-5-0546	Potential Direct Impact	Moderate – Poor	Moderate
BCRP 015	52-5-0547	Potential Direct Impact	Poor	Low
BCRP 028	52-2-1797	Potential Direct Impact	Moderate	Moderate

Note: For a full list of Aboriginal heritage sites see **Section 6.3.7**.

16.2.1 Aboriginal Cultural Significance

Non particular cultural significance was raised during consultation with the local Aboriginal community for the Northern Option.

16.3 Aboriginal Heritage Assessment of the Southern Option

The Southern Option would directly impact on 1 sites of moderate Aboriginal archaeological significance and 2 sites of low archaeological significance, as shown in **Table 16.3**.

The item of moderate archaeological significance is a large sandstone shelter on the eastern side of Bomaderry Creek gorge which contained 8 artefacts, and through which the Bomaderry Creek Reserve walking trail runs. Some level of salvage excavation would potentially be required at this site prior to construction.

Table 16-3: Aboriginal Sites Directly Impacted by the Southern Option

Report ID	AHIMS ID	Description of Potential Impact	Condition	Archaeological Significance
BCRP 019	52-5-0551	Potential Direct Impact	Moderate	Low
BCRP 026	52-5-0557	Potential Direct Impact	Poor	Low
BCRP 027	52-5-0558	Potential Direct Impact	Moderate	Moderate

Note: For a full list of Aboriginal heritage sites see **Section 6.3.7**.

16.3.1 Aboriginal Cultural Significance

In addition to the potential direct impact on a site of moderate archaeological significance, discussions in the field with Aboriginal representatives, have identified that the perceived cultural significance (and archaeology) of the gorge is greatest around the area where it is crossed by the Southern Option.

16.4 Comparison of Options

There are two separate issues of in relation to the comparative assessment of the Aboriginal heritage impacts of the 3 options. These are:

- Impact to Aboriginal heritage items that are of moderate or high archaeological significance.
- Impact to areas that are of cultural significance for the local Aboriginal community

Table 16.4 shows a comparative ranking of each of the route options against the 2 key Aboriginal heritage criteria. The total scores provided in the table are the sum of the ranking score for each criteria, and a lower score is the best result, showing that an option has ranked well across both criteria.

Table 16-4: Ranking of the Route Options Against Aboriginal Heritage Criteria

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Impact on Archeologically Significant Aboriginal heritage items	1	2	3
Impact on an Area of Cultural Aboriginal Significance	1	3	1
Total Score	**2**	**5**	**4**

Note: The lowest score is the best performing route option.

Table 16.4 shows that the Central Option is the best performing option in regards to Aboriginal heritage. It does not potentially impact on any Aboriginal heritage items of moderate or high archaeological significance, and it does not impact on an area of cultural significance for the local Aboriginal community. This is consistent with advice provided by local Aboriginal community which prefers the Central Option compared with the other 2 route options.

The Northern Option would potentially directly impact on 2 Aboriginal heritage items of moderate significance, and the Southern Option would potentially directly impact on the part of the Bomaderry Creek gorge which has the highest cultural significance for the local Aboriginal community.

16.5 Mitigation Measures

As indicated above, detailed design should be able to avoid or minimise impacts to Aboriginal heritages sites.

If complete avoidance is not possible and sites are only partially impacted then the remaining portion of the sites will be identified in an Environmental Management Plan (EMP) and protected from inadvertent impact with temporary fencing along the construction boundary. No signage identifying the area as having Aboriginal significance will be erected, signage stating 'Significant Environmental Area – No Entry Permitted' may be erected if appropriate, and as agreed with DECCW and the Aboriginal community.

17.0 Soils and Water

The key soil and water issues include the soil erodibility, watercourses that the road may impact upon, ground water issues, potential flooding impacts and contaminated soils.

17.1 Flooding Impact Assessment

Section 6.3.5 details the general flooding characteristics of Bomaderry Creek. Potential impacts associated with flooding will occur during the operational stage of the bridges. Bridge design for all three options could influence the impact on flooding of Bomaderry Creek and adjacent areas. This includes impacts associated with bridge height, number of piers in or directly adjacent to the creek that may lead to restriction of flood waters, increased scouring of the creek banks and/or changes in peak flow velocities.

WBM, who was commissioned by Council to carry out a detailed Bomaderry Creek Flood Study, was also commissioned to provide advice in regards to the levels and affect that flooding constraints would have on the design of each of the route options. The WBM advice is provided in Appendix I.

The flood levels, the level of abutments and the level of pier footings for each option are shown in **Table 17.1** and the preliminary design details for the bridges are provided in **Appendix D**.

Table 17-1: Bridge Parameters Affecting Flooding

Parameter	Central Route Option	Northern Route Option	Southern Route Option
Level of the Bridge Carriageway	35 m AHD	35 m AHD	38 m AHD
Flood Level at the Bridge Location	25 m AHD	31 m AHD	10 m AHD
Approximate Level of the Creek Bed at Bridge Location	21 m AHD	24 m AHD	9 m AHD
Number of Piers with footings within the ARI 100 flood level	1	3	1

Bridges can be designed for three route options that will largely avoid the flooding constraints at each site. Because of their location in the Bomaderry Gorge bridges for Route Options 1 and 2 have few flooding constraints and the footings of piers could be located at the outer extent or above the level of the 1:100 year Annual Recurrence Interval (ARI) flood event. However, bridges for Options 1 and 2 will require long spans to ensure no pier or footing is constructed in the creek bed, which could otherwise cause an obstruction in the creek. There are also significant constraints for Options 1 and 2, in gaining access to construct bridge piers or footings at the base of the sheer sandstone rock faces, particularly at the Option 2 bridge site.

Where option 3 crosses the creek the valley it is a broader shape with a relief of about 5m at the creek. Because of the width of the channel at this location, the width of the 1:100 year ARI flood level is approximately 60 m. The preliminary bridge design includes 3 piers and their footings being located within the 100 ARI level, although none of the pier footings are proposed to be located in the creek itself.

All three bridge options can be designed to be above a 1:100 year ARI flood. Little constriction will occur to the available waterway area beneath either structure as along as a minimal number of piers/ footings are within the creek banks and the bridge abutments are beyond the creek banks.

This means that there will be only minor changes to peak flow velocities, so there would be little potential for additional scouring or further upstream inundation due to afflux.

17.2 Water Quality Impacts

The existing water quality for Bomaderry Creek is good, with the exception of slightly elevated phosphorus concentrations. The main short term risks to water quality for all the North Nowra Link Road options will occur during the construction stage. Potential impacts include:

- Over clearing through poor delineation of the construction easement or vegetation to be retained increasing the overall area of disturbance.
- Degradation of topsoil through poor handling and stockpiling.
- Soil erosion through the loss of vegetation cover and breaking up and milling of sandstone bedrock for construction purposes.
- Transport of eroded sediment to adjacent bushland and/or flow lines.
- Contamination of Bomaderry Creek and groundwater from hydrocarbon spills, sawcutting or poor management of concrete waste products.
- Introduction of weeds from plant, machinery and vehicles.
- Exposure of leachates and waste contaminants from the former landfill site on Route Option 2.

Route Option 2 is the longest in length of all the three route options. Therefore, the area of disturbance required to construct this Option will be the greatest, increasing the risk of erosion. The level of disturbance, within the riparian corridor, required to construct Option 2's bridge will be greater than that for the other two Route Options due to the width of the gorge in this location and the lack of existing suitable access to construct footings/ piers for the bridge.

During the operation stage, potential impacts on water quality for all three route options include:

- Increased surface runoff due to an increase in impervious surfaces, bridge runoff and concentration of runoff by drains and stormwater pipes.
- A build-up of pollutant deposits (e.g. oils, brake dust) from vehicles on the sealed road and bridge surfaces which build up during dry weather and then carried downstream during rainfall events to areas where they can adversely impact upon water quality.
- Contamination of the perched water tables associated with the Sandstone Sedgeland Vegetation Community by road surface pollutants being transported during rain events.
- Hydrocarbon or other pollutant spills on the road and/ or bridge that could enter Bomaderry Creek.
- Increased flow velocities from stormwater drainage leading to scouring.

These impacts associated with the construction and operation stages of the road for all three route options can all be prevented or minimised through appropriate stormwater and bridge design and the implementation of appropriate mitigation measures.

It is proposed that all bridge discharge will be treated, by directing all bridge drainage to gross pollutant traps installed at the base of the piers. During detailed design, the need for further treatment will be investigated, and if necessary sand filtration will be considered.

17.2.1 Water Quality Mitigation

Any of the corridors would require an Erosion and Sediment Control Plan followed by a Soil and Water Management Plan as part of final design.

The design itself would incorporate best practice objectives of water sensitive urban design principles. Specialist consultants would be engaged by the project design team to identify water quality targets compatible with the aquatic ecosystems in Bomaderry Creek.

Water quality safeguards would include rehabilitation, sedimentation ponds, erosion controls where surface runoff is concentrated and other conventional measures for water sensitive design.

17.2.2 Erosion and Sedimentation Control

Minimal erosion was observed during the site investigation of all three Route Options undertaken in early May 2010. The only areas actively eroding were an access track associated with the water and power line corridor that runs parallel to Route Option 1 and along the walking tracks. The erosion that was observed in these locations is minimal and was confined to minor sheet and rill erosion. The potential for erosion and offsite sedimentation, during the construction and operation stages, prior to the stabilisation of all disturbed areas associated with the project will be increased along all three route options. Adverse impacts associated with erosion and off-site sedimentation during the construction and post-construction stage include:

- Loss of topsoil with native seed in it.
- Decrease in water quality, impacting upon the aesthetics, recreational use and aquatic fauna and flora of and in Bomaderry Creek.
- Degradation of adjacent areas of native vegetation.
- Introduction of weed species.
- Increase in the sediment load of Bomaderry Creek, which could ultimately impact on the lower reaches of Bomaderry Creek and the Shoalhaven River.
- Increased costs associated with reinstating rehabilitated areas that have been eroded or covered in sediment.
- Exposure of contaminated soil materials associated with the former landfill site along Route Option 2.

These impacts can all be prevented or minimised through appropriate design and the implementation of the appropriate erosion and sedimentation mitigation measures.

17.3 Groundwater Impacts

It is anticipated that the construction of the North Nowra Link Road will have no impact on groundwater along any of the Route Options. However, there is the potential to adversely impact upon the Sandstone Sedgeland vegetation community along Route Options 1 and 2, by altering the flow regimes to these areas. Surface runoff recharges the groundwater in these areas and therefore these flow paths must be retained to ensure the flow regime to these areas remains the same as prior to the construction of the road.

As part of further geotechnical investigations required for road design investigation into the current groundwater levels and flows will be investigated and the importance of the groundwater flow regime to the sandstone sedgeland vegetation community will be identified.

17.4 Impacts on Riparian Corridor

Given that the riparian corridor along Bomaderry Creek is classified as Category 1 - environmental corridor - with a recommended minimum core riparian zone of 40m either side of the creek, the construction of the bridge and its approaches will potentially have an impact on the riparian zone for construction of the bridge for all the NNLR Route Options.

The height of the bridge for all three Route Options will determine the amount of light and rainfall drift beneath the bridge, which will determine the type of vegetation that will eventually grow within the light and rainfall shadow of the bridge.

Because of the depth of the Bomaderry Creek Gorge at the crossing point, for Option 2 there is a significant height differential between the riparian vegetation and the underside of the bridge. As such there will be minimal ongoing impact to riparian vegetation. Option 1 will provide sufficient clearance for the movement of fauna under the bridge and through the Bomaderry Creek Gorge riparian vegetation. Due to the flatter topology of the gorge, Option 3 will result in a bridge structure with minimal clearance off the Bomaderry Creek banks, however there is only a very small amount of riparian vegetation north of the bridge crossing.

The bridge structure will be designed and constructed to minimise impacts to the Bomaderry Creek Gorge riparian vegetation.

17.5 Contaminated Land Assessment

The former solid waste landfill adjacent to the southern edge of the Bomaderry Creek Regional Park could potentially be contaminated, although testing results indicate that there is no evidence of contaminant migration from the site.

Option 1, the Central Option, would pass well upstream (at least 350m) of the former landfill and current leachate management ponds. It would therefore have no impact on potentially contaminated lands provided surface runoff from the road is properly managed. There are no other known contamination risks associated with the Central Option and there are no known historical uses which would indicate that there would be ground contamination along the route. Similarly there are no known contamination issues associated with Option 3, the Northern Option.

Apart from appropriate stormwater management measures to control surface water run-off, no mitigation measures are likely to be necessary for the Northern or Central route options, unless evidence of contamination was found during detailed geotechnical and site investigations or construction. If evidence of contamination was discovered during detailed geotechnical and site investigations or construction then DECCW consulted and an appropriate strategy for dealing with the contamination agreed.

The southern route would pass immediately to the south east of the leachate management ponds and would follow a section of the former leachate discharge channel. This would have the potential to re-mobilise contaminants currently held in the soil.

Further geotechnical studies will be required to determine the ability of the landfill site to have a road constructed along its southern edge and possible mitigation measures that might be required. If the southern corridor is to be constructed, a detailed contaminated land investigation of the land surrounding the former landfill site would also be necessary as part of detailed design.

If contamination is found, remediation may be required, and the proposed strategy for remediation of contaminated land would be discussed with DECCW during the subsequent stages of design to ensure that the land would be considered suitable for use, prior to the commencement of any constructions works on the affected lands.

17.6 Comparison of Route Options

Key issues include the shallow, erodible soils and potential high run on water for each route (particularly Route Options 1 and 2), potential flooding issues, potential contamination issues associated with Route Option 2, the impacts of all the bridges on the riparian corridor and the required access to construct the bridges (particularly for Option 2 and to a lesser extent Option 1).

Table 17.2 shows a comparative ranking of each of the route options against soil and water parameters. The table ranks the options with the lower ranking being the better performing option. The parameters that were considered to be differentiators for the 3 route options were:

- Potential flooding impacts.
- Potential impact on contaminated land
- Potential impact on riparian vegetation.

The total scores provided in the table are the sum of the ranking score for each parameter, and a lower score is the best result, showing that an option has ranked well across the most parameters.

The table shows that Option 1 performs better than the others, because it has minimal impacts to flooding and contaminated land. The Northern Option would result in potentially the most significant impacts to riparian vegetation, due to the relative shallowness of the banks for Bomaderry Creek in this location, as well flooding, with a number of piers required within the 1:100 ARI flood level. However, Option 3 represents the most significant risk due to the uncertainty associated with the geotechnical stability and the potential contamination associated with the former landfill site. If the Southern Option was selected then further detailed investigations would need to occur, and remediation of the road corridor may be required to make the land suitable for use as a public road.

Table 17-2: Summary of Key Soil and Water Indicators for Comparison of Options

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Impacts on Flooding	1	1	3
Impacts on Contaminated Land	1	3	1
Impact on Riparian Vegetation	2	1	3
Total Score	**4**	**5**	**7**

Note: The lowest score is the best performing route option.

18.0 Socio-economic

18.1 PARAMICS Economic Appraisal

The AECOM PARAMICS study addressed the key issue of economics in comparing the route options. Economic appraisals determine the benefits generated relative to the expenditure required to develop a project. The economic appraisal used a cost benefit framework to assess the desirability of each option and compared the options against a "do minimum" base cost.

Urban based economic parameters from the RTA Economic Analysis Manual were used. The appraisal focused on the benefits and costs accrued by road users, which included vehicle operating cost savings, travel time savings, accident cost savings, construction costs and maintenance costs. Table 18.1 summarises the economic costs and benefits estimated for each route option.

Overall benefits were identified by estimating the following:

- Vehicle operating cost saving – being fuel and oil, depreciation, maintenance and wear on tyres and brakes.
- Travel time cost savings – which take into account vehicle type, vehicle composition, vehicle occupants, presence of freight, and temporal changes in value over time.
- Accident cost savings – which includes the costs of accidents, including human medical costs, vehicle repair and towing costs and general costs associated with travel delays, police and property.

The costs that were applied as inputs into the AECOM economic analysis were:

- Construction costs – which include the construction of the new road and bridges, intersection improvements, land acquisition, survey, design and other investigations, project management, services, clearing, fencing and security. In the absence of detailed design, capital costs for each option were based on unit rates and conceptual designs, which include mitigation measures that are known or expected to be required at this time. These costs will be modified as mitigation issues are identified and the design is finalised. (Note: the most recent cost estimates provided in Section 7 take into account the more advanced designs carried out and the proposed mitigation measures. Section 18.2.2 explains that sensitivity testing confirms that the economic analysis remains valid for these more recent construction cost estimates.)
- Maintenance costs – Council estimates that each additional kilometre of road costs $26,200 per annum to maintain. Bridge maintenance is estimated at 1.3% of the original construction costs per annum (typically current estimate of full replacement value divided by 80 years).

Table 18-1: Summary of Key Economic Cost and Benefit Inputs

Benefit or Cost Input	Central Route Option	Southern Route Option	Northern Route Option
Vehicle Operating Cost Savings	- $0.3 M	$0.8 M	- $2.1 M
Travel Time Cost Savings	$20.1 M	$23.0 M	- $1.1 M
Accident Cost Savings	- $0.5 M	- $0.2 M	- $0.6
Total Benefits	**$19.4 M**	**$23.6 M**	**- $3.8 M**
Construction Costs	$7.3 M	$12.0 M	$7.7 M
Annual Maintenance Costs	$0.9 M	$1.1 M	$0.7 M
Total Costs	**$8.2 M**	**$13.2 M**	**$8.4 M**

Note: Monetary values in thousands of $2007 discounted at a real discount rate of 7% per annum. All values have been rounded to the nearest $0.1M.

Benefits were determined by normalising the Vehicle Kilometres Travelled (VKT) and Vehicle Hours Travelled (VHT) for the base case and each of the options, calculating the ratio of projected vehicles (between each respective option and the base case), and multiplying this ratio by the respective forecasts for each option of VKT of VHT.

18.2 Results of Economic Assessment

The key indicators used in the economic assessment were:

- Net present value (NPV);
- Net present value per dollar of investment (NPVI);
- Benefit Cost Ratio (BCR); and
- The Internal Rate of Return (IRR).

Table 18.2 summarises the main economic indicators for the three corridor options.

Table 18-2: Summary of Key Economic Indicators

Economic Indicator	Central Route Option	Southern Route Option	Northern Route Option
Benefits	$19.4 M	$23.6 M	- $3.8 M
Costs	$8.2 M	$13.2 M	$8.4 M
NPV	$11.2 M	$10.5 M	-$12.2
BCR	2.4	1.8	-0.50
IRR	17.9%	13.8%	Undefined
NPVI	1.5	0.9	-1.6

Note: Monetary values in thousands of $2007 discounted at a real discount rate of 7% per annum. All values have been rounded to the nearest $0.1M.

18.2.1 Future Improvements to Road network

The AECOM economic assessment also considered the possible future road network improvements being the Moss Vale Road link (MVRDLK) and River Crossing Relief (RCR) improvements, so that the additional benefits of these infrastructure improvements which were assessed as being significant, were not viewed in isolation of the additional costs of providing those works. Economic analysis of Option 1 and Option 3 were modelled in the AECOM report with these road improvements in place, and the results are shown in **Table 18.3**. The results show that the benefit cost ratios are improved by implementing the North Nowra Link Road in tandem with future predicted improvements to the local traffic network.

The results in Tables 18-2 and 18-3 show that the NNLR can stand alone as a project that in isolation results in network benefits exceeding the cost of providing the new link; whereas the later cumulative assessments (in conjunction with other works) shows that the NNLR is only one important element of the overall broader infrastructure improvements (including Highway upgrades) required to further improve network performance and contribute considerable additional benefit to the community, by addressing congestion and catering for future growth.

When comparing Table 18-2 and Table 18-3 it is noted that Table 18-3 shows a closer comparison of BCR ratio between the Central and Northern Options than is apparent in Table 18-2. However this is attributed to the additional benefits associated with the proposed Illaroo Road to Moss Vale Road link and not directly associated with the Northern option which in isolation returns a dis-benefit (i.e. a loss).

Table 18-3: Summary of Key Economic Indicators taking into account Future Road Improvements

Economic Indicator	Central Option + Moss Vale Link Road	Central Option + RCR	Northern Option + Moss Vale Link Road
Benefits	$38.1 M	$44.4 M	$34.1 M
Costs	$19.0 M	$10.9 M	$19.2 M
NPV	$19.1 M	$33.6 M	$14.8 M
BCR	2.0	4.1	1.8
IRR	15.5%	28.5%	13.6%
NPVI	1.1	3.4	0.8

Note: Monetary values in thousands of $2007 discounted at a real discount rate of 7% per annum. All values have been rounded to the nearest $0.1M.

18.2.2 Sensitivity Analyses

During the project development further information has became available to Council including a better understanding of the costs of intersection layouts, wider bridges to satisfy new national standards, land acquisition, clearing costs, noise attenuation and relocation of services.

The AECOM report included a sensitivity analysis that tested operating cost increases and decreases of 20% and construction cost contingency up to 50%, which did not affect the comparative results. All recent variations were within this range, so the economic analysis and conclusions remained valid.

Sensitivity analyses were also used to test the robustness of the model. This included testing the benefit cost ratios against different discount rates, contingencies, value of time and other parameters. This sensitivity testing confirmed the rankings between options remained the same.

18.3 Social Impacts

The AECOM report incorporated traffic accident data provided by the RTA. Two hundred and ninety one (291) accidents occurred in the study area between mid 2000 and mid 2005. This averaged about 60 accidents per year, ranging from 44 to 74 annual incidents. Forty three of these occurred on Illaroo Road.

The AECOM report concluded that diverting traffic away from Illaroo Road to the Link Road could be significant in reducing the number of accidents on Illaroo Road. Similarly, diversion of this traffic may defer the need to upgrade Illaroo Road intersections. AECOM also confirmed that if a link road is not constructed to relieve traffic on Illaroo Road, safety conditions are likely to worsen due to continual traffic growth and deteriorating environmental amenity.

The NNLR Central Option would enhance public enjoyment and encourage recreational activity by increasing the awareness of and giving easier access to facilities in the Regional Park. Those facilities include the car park and picnic areas, walking tracks and educational displays, as well as the Bomaderry Creek Weir. In particular the Central Option could be optimised to include upgraded access to the picnic facilities, upgraded picnic facilities, viewing platforms off the new bridge with educational displays could be provided and linked to walking tracks, etc. This has the potential to add significant benefit to Option 1 (Central Option) and mitigate perceived impacts associated with a new NNLR in this location.

The connectivity gains to the community would provide unprecedented access improvements to North Nowra and between North Nowra and the Princes Highway and Bomaderry for residences and businesses alike. This has the potential to flow on to freight savings and in general the potential for cheaper goods and services in the area. The Central Option would afford better vehicular entry and exit for emergency service vehicles, and escape routes during emergencies, fires and hazard reduction operations.

It would also provide for improved surveillance by passing traffic of parts of the Park. In particular, the current behaviour near and inside the Bomaderry Creek Regional Park is aggravated by a lack of supervision and exposure to other people using the area. There have been a number of dumped cars along the alignment for the Central Option because there is currently good access provided by the existing transmission line and water pipeline service road. Increased surveillance of passing traffic and appropriately placed traffic barriers will curtail anti-social behaviour in this section of the Park. It would also increase the potential to give the North Nowra and Bomaderry communities a greater sense of pride and ownership of the Regional Park.

It is unlikely that the Northern and Southern Options would result in any significant increase in the awareness of the Regional Park and its facilities due to their location at the very extremities of the Park well away from the main entrance to the park and it facilities. Further, the Northern and Southern route options would not increase surveillance through the cleared services corridor and so the ongoing problems of vandalism and anti-social behaviour in this part of the Regional Park would be likely to continue. Finally, consider that the traffic and economic benefits are maximised by Option 1, the Northern and Southern Options would not result in as significant benefits in regards to community access, movement of materials and emergency vehicle access.

18.4 Comparison of Options

The Central Option and the Southern Option were found to be economically justifiable. This was validated for all scenarios tested in the sensitivity analysis. The Northern Option in isolation would not be economically viable.

The Moss Vale Road link was found to be economically viable in conjunction with the Central Option (Option 1).

There are apparent benefits of the Moss Vale Road Link when considered in conjunction with Option 3 (Northern route) however, this is attributed to the benefits associated with the proposed Illaroo Road to Moss Vale Road Link and not directly associated with the Northern Option which in isolation returns a dis-benefit (loss).

From **Table 18.4** it is clear that on economic grounds the Central Option outranks the Southern and Northern Options.

Table 18-4: Ranking of Key Economic Indicators

Economic Indicator	Central Route Option	Southern Route Option	Northern Route Option
NPV	1	2	3
BCR	1	2	3
IRR	1	2	3
NPVI	1	2	3
Total Score	**4**	**8**	**12**

Note: The lowest score is the best performing route option.

19.0 Environmental Risk Analysis

The Environmental Risk Assessment for the North Nowra Link Road Concept Plan has been adapted from Australian Standard AS4369:1999 Risk Management and environmental risk tools developed by other organisations (summarised at **Table 19.1**). An Environmental Risk Assessment has been carried out for each of the 3 route options, and they are provided in **Table 19.2**, **Table 19.3** and **Table 19.4** for Option 1, 2 and 3 respectively. The Environmental Risk Assessment establishes a residual risk by reviewing the 'significance of environmental impacts' and the 'ability to manage those impacts'.

The significance of environmental impacts is assigned a value between 1 and 5 based on:

- The receiving environment;
- The level of understanding of the type and extent of impacts; and
- The likely community response to the environmental consequence of the project;

The manageability of environmental impact is assigned a value between 1 and 5 based on:

- the complexity of mitigation measures;
- the known level of performance of the safeguards proposed; and
- the opportunity for adaptive management.

The sum of the values assigned provides an indicative ranking of potential residual impacts after the mitigation measures are implemented.

Table 19-1: Environmental Risk Matrix

Significance of Impact	Manageability of Impact				
	5 Complex	4 Substantial	3 Elementary	2 Standard	1 Simple
1 - Low	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)	2 (Low)
2 - Minor	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)
3 - Moderate	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)
4 - High	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)
5 - Extreme	10 (High)	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)

Table 19-2: Environmental Risk Analysis for Option 1 – The Central Option

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
Biodiversity	C + O	Direct Impacts to threatened species *Hibbertia sp. Nov. 'Menai'* and *Eucalyptus langleyi.* Indirect Impacts to *Zieria baeuerlenii.* Clearing of vegetation which is habitat to a range of threatened species including: Giant Burrowing Frog Gang-gang Cockatoo Glossy Black-Cockatoo Square-tailed Kite Masked Owl Powerful Owl Large-footed Myotis Spotted-tail Quoll Grey-headed Flying-fox Yellow-bellied Glider	<u>Zieria and other Flora Mitigation Measures</u> Measures during construction works include workforce education, fencing of specimen and erosion and sedimentation control measures Operational measures include fencing specimen, retaining, where possible shade trees, minimising access, species propagation and road verge management to reduce the risks of incidental fires and mange weeds. <u>Fauna Mitigation Measures</u> Measures during construction works include pre-clearing surveys of tree hollows, timing of clearing to avoid high rainfall periods & high bushfire risk periods, clearing methods to minimise impacts to adjacent habitats and education of workforce. Provision of overpasses for arboreal species in the form of rope bridges or gliding poles. Road design to minimise roadkill events, including signage and provision of high contrast road pavement to help see fauna crossing. Bridge design to maintain movement of terrestrial and aquatic species.	Section 13 Appendix F	3	4	7 (High/ Medium)
Traffic	C + O	Benefits for traffic on local roads and the Princes Highway Temporary traffic disruption on local roads during construction.	Traffic management plans will be implemented during construction to minimise impacts on local residents.	Section 12 Appendix E	2	2	4 (Low/ Medium)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
Noise	C + O	Increase in noise levels during construction activities Increase in noise levels from road traffic to local residents. Increase in noise levels from road traffic to Regional Park users.	Further detailed noise modelling during detailed design to investigate the inclusion of noise mitigation measures, being noise walls or berms, and the type of the pavement to be used. Adoption of a noise management plan to minimise noise from construction.	Section 14 Appendix E	3	2	5 (Low/ Medium)
Visual	O	Visual impact from local residential properties to the new road. Visual impact to users of the Bomaderry Creek Regional Park facilities and walking trails.	Landscaping will provided as part of the detailed design.	Section 15 Appendix H	2	3	5 (Low/ Medium)
Aboriginal Heritage	C + O	Impact on Aboriginal heritage items of low significance.	Detailed design of the road will avoid direct impacts where possible.	Section 16 Appendix G	2	1	3 (Low)
European Heritage	C + O	Potential impact to Bomaderry Creek Weir during construction. Impact to the setting and context of the Bomaderry Creek Weir.	Will increase awareness of the weir. The Central Option could facilitate interpretive displays and a viewing platform off the Option 1 bridge that could allow the community to better understand and appreciate the cultural significance of the weir.	Appendix J	2	1	3 (Low)
Soil and Water Quality	C + O	Impact to water quality in Bomaderry creek from runoff during construction and operation.	During construction, erosion and sediment controls will be undertaken in accordance with the construction management plan. Stormwater from the bridge will be directed to stormwater treatment devices prior to controlled discharge into the creek. The location of structures in the 1:100 ARI flood level will be minimised during detailed design.	Section 17	1	2	3 (Low)
Socio-Economic	O	Impact to amenity of Bomaderry Creek Regional Park.	No mitigation measure proposed.	Section 18	2	2	4 (Low/ Medium)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
		Increase awareness and security (by visual surveillance) of Bomaderry Creek Regional Park.					
Air Quality	C + O	No deterioration in local air quality. Improving the efficiency of the local road network would result in positive air quality outcomes. Potential dust impacts during construction.	Dust management would be addressed as part of the Construction Environmental Management Plan.	NA	1	1	2 (Low)
Contamination	C	No contamination likely along route corridor	Soil characteristics, including possible contamination, to be confirmed as part of detailed site investigations for detailed design.	Section 17	1	1	2 (Low)
Waste	C	Generation of waste	Waste management would be addressed as part of the Construction Environmental Management Plan. This would include initiatives such as: Investigate the use of recycled materials in construction materials; Maximisation of the recycling of wastes where possible; and All waste for disposal would be removed by a licensed waste contractor and disposed of at a licensed landfill facility.	NA	2	1	3 (Low)

Table 19-3: Environmental Risk Analysis for Option 2 – The Southern Option

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
Biodiversity	C + O	Direct Impacts to threatened species *Hibbertia sp. Nov. 'Menai'* and *Genoplesium baueri*. Clearing of vegetation which is habitat to a range of threatened species including: Gang-gang Cockatoo Glossy Black-Cockatoo Square-tailed Kite Masked Owl Powerful Owl Large-footed Myotis Spotted-tail Quoll Grey-headed Flying-fox Yellow-bellied Glider	<u>Flora Mitigation Measures</u> Measures during construction works include workforce education, fencing of specimen and erosion and sedimentation control measures Operational measures include road verge management to reduce the risks of incidental fires and mange weeds. <u>Fauna Mitigation Measures</u> Measures during construction works include pre-clearing surveys of tree hollows, timing of clearing to avoid high rainfall periods & high bushfire risk periods, clearing methods to minimise impacts to adjacent habitats and education of workforce. Provision of overpasses for arboreal species in the form of rope bridges or gliding poles. Road design to minimise roadkill events, including signage and provision of high contrast road pavement to help see fauna crossing. Bridge design to maintain movement of terrestrial and aquatic species.	Section 13 Appendix F	3	3	6 (Medium)
Traffic	C + O	Benefits for traffic use on local roads and the Princes Highway Temporary traffic disruption on local roads and the Princes Highway during construction.	Traffic management plans will be implemented during construction to minimise impacts on local residents.	Section 12 Appendix E	3	2	5 (Low/ Medium)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
Noise	C + O	Increase in noise levels during construction activities Increase in noise levels from road traffic	Further detailed noise modelling during detailed design to investigate the inclusion of noise mitigation measures, being noise walls or berms, and the type of the pavement to be used. Adoption of a noise management plan to minimise noise during construction.	Section 14 Appendix E	3	3	6 (Medium)
Visual	O	Visual impact from local residential properties to the new road. Visual impact to users of the walking trails which connect to the Bomaderry Creek Regional Park walking trails.	Landscaping will be provided as part of detailed design	Section 15 Appendix H	2	3	5 (Low/ Medium)
Aboriginal Heritage	C + O	Impact on Aboriginal heritage items of moderate to low significance. Impact on the cultural significance the Bomaderry Creek Gorge at the location of the bridge crossing, depending on which option is selected.	Some salvage operations may be required depending on the option selected.	Section 16 Appendix G	3	2	5 (Low/ Medium)
European Heritage	C + O	No heritage items in proximity to the route corridor	No mitigation proposed	Appendix J	1	1	2 (Low)
Soil and Water Quality	C + O	Impact to water quality in Bomaderry creek from runoff during construction and operation.	During construction, erosion and sediment controls will be undertaken in accordance with the construction management plan. Stormwater from the bridge will be directed to stormwater treatment devices prior to controlled discharge into the creek. The location of structures in the 1:100 ARI flood level will be minimised during detailed design.	Section 17	1	2	3 (Low)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
Socio-Economic	O	Private properties directly affected, requiring compulsory acquisition.	Acquisition will be carried out in accordance with NSW legislation and Council procedures.	Section 18	3	2	5 (Low/ Medium)
Air Quality	C + O	No deterioration in local air quality. Improving the efficiency of the local road network would result in positive air quality outcomes. Potential dust impacts during construction.	Dust management would be addressed as part of the Construction Environmental Management Plan.	NA	1	1	2 (Low)
Contamination	C	Potential impact to contaminated soil and groundwater associated wit the former landfill site.	Further detailed geotechnical and contamination investigations required to adequately characterise the nature of any contamination around the former landfill site. Remediation of contamination may be required.	Section 17	3	3	6 (Medium)
Waste	C	Generation of waste dyring construction	Waste management would be addressed as part of the Construction Environmental Management Plan. This would include initiatives such as: Investigate the use of recycled materials in construction materials; Maximisation of the recycling of wastes where possible; and All waste for disposal would be removed by a licensed waste contractor and disposed of at a licensed landfill facility.	NA	2	1	3 (Low)

Table 19-4: Environmental Risk Analysis for Option 3 – The Northern Option

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
Biodiversity	C + O	Clearing of vegetation which is habitat to a range of threatened species including: Giant Burrowing Frog Gang-gang Cockatoo Glossy Black-Cockatoo Square-tailed Kite Masked Owl Powerful Owl Large-footed Myotis Spotted-tail Quoll Grey-headed Flying-fox Yellow-bellied Glider	Vegetation Management Measures Measures during construction works include workforce education, and erosion and sedimentation control measures Operational measures include road verge management to reduce the risks of incidental fires and mange weeds. Fauna Mitigation Measures Measures during construction works include pre-clearing surveys of tree hollows, timing of clearing to avoid high rainfall periods & high bushfire risk periods, clearing methods to minimise impacts to adjacent habitats and education of workforce. Provision of overpasses for arboreal species in the form of rope bridges or gliding poles. Road design to minimise roadkill events, including signage. Bridge design to maintain movement of terrestrial and aquatic species.	Section 13 Appendix F	2	2	4 (Low/ Medium)
Traffic	C + O	Benefits for traffic use on local roads and the Princes Highway Temporary traffic disruption on local roads and Moss Vale Road during construction.	Traffic management plans will be implemented during construction to minimise impacts on local residents.	Section 12 Appendix E	3	2	5 (Low/ Medium)
Noise	C + O	Increase in noise levels during construction activities Increase in noise levels from road traffic to local residents.	Further detailed noise modelling during detailed design to investigate the inclusion of noise mitigation measures, being noise walls or berms, and the type of the pavement to be used. Adoption of a noise management plan to minimise noise	Section 14 Appendix E	3	3	6 (Medium)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
			from construction.				
Visual	O	Visual impact from local residential properties to the new road (including noise treatments).	Landscaping will provided as part of the detailed design.	Section 15 Appendix H	2	3	5 (Low/ Medium)
Aboriginal Heritage	C + O	Impact on Aboriginal heritage items of moderate significance.	Detailed design of the road will avoid direct impacts where possible.	Section 16 Appendix G	2	2	4 (Low/ Medium)
European Heritage	C + O	No heritage items in proximity to the route corridor	No mitigation proposed	Appendix J	1	1	2 (Low)
Soil and Water Quality	C + O	Impact to water quality in Bomaderry creek from runoff during construction and operation. Impact to flood flows in the Bomaderry creek Catchment from location of structures in the 1:100 ARI flood level.	During construction, erosion and sediment controls will be undertaken in accordance with the construction management plan. Stormwater from the bridge will be directed to stormwater treatment devices prior to controlled discharge into the creek. The location of structures in the 1:100 ARI flood level will be minimised during detailed design.	Section 17	2	2	3 (Low/ Medium)
Socio-Economic	O	Private properties directly affected, requiring compulsory acquisition.	Acquisition will be carried out in accordance with NSW legislation and Council procedures.	Section 18	3	2	5 (Low/ Medium)
Air Quality	C + O	No deterioration in local air quality. Improving the efficiency of the local road network would result in positive air quality outcomes. Potential dust impacts during	Dust management would be addressed as part of the Construction Environmental Management Plan.	NA	1	1	2 (Low)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures	Where Assessed in EAR	Risk Assessment		
					Significance of Impact	Manageability of Impact	Residual Impact
		construction.					
Contamination	C	No contamination likely along route corridor	Soil characteristics, including possible contamination, to be confirmed as part of detailed site investigations for detailed design.	Section 17	1	1	2 (Low)
Waste	C + O	Generation of waste	Waste management would be addressed as part of the Construction Environmental Management Plan. This would include initiatives such as: Investigate the use of recycled materials in construction materials; Maximisation of the recycling of wastes where possible; and All waste for disposal would be removed by a licensed waste contractor and disposed of at a licensed landfill facility.	NA	2	1	3 (Low)

19.1 Comparison of Options

The overall residual risk score for each issue was compared with a view to compare the relative environmental risk of each option. The results are summarised in **Table 19.5**. As with previous comparison tables the lower score indicates a lower overall risk.

Table 19-5: Comparative Environment Risk Assessment Scores

Risk Indicator	Central Route Option	Southern Route Option	Northern Route Option
Biodiversity	7 (High/ Medium)	6 (Medium)	4 (Low/ Medium)
Traffic	4 (Low/ Medium)	5 (Low/ Medium)	5 (Low/ Medium)
Noise	5 (Low/ Medium)	6 (Medium)	6 (Medium)
Visual	5 (Low/ Medium)	5 (Low/ Medium)	5 (Low/ Medium)
Aboriginal Heritage	3 (Low)	5 (Low/ Medium)	4 (Low/ Medium)
European Heritage	3 (Low/ Medium)	2 (Low)	2 (Low)
Soil and Water Quality	3 (Low)	3 (Low)	3 (Low/ Medium)
Socio-Economic	4 (Low/ Medium)	5 (Low/ Medium)	5 (Low/ Medium)
Air Quality	2 (Low)	2 (Low)	2 (Low)
Contamination	2 (Low)	6 (Medium)	2 (Low)
Waste	3 (Low)	3 (Low)	3 (Low)
Total Score	**41**	**48**	**41**

Note: The lowest score is the best performing route option.

PART D
Route Selection, Revocation, Project Justification and Conclusions

20.0 Selection of the Preferred Route

The three corridors can be ranked against the key environmental and socio-economic issues discussed above. There are no exact definitive ways of integrating the relative strengths and weaknesses of each route option against the various issues of concern.

While there appears to be a strong community preference for a North Nowra Link Road to be constructed, there is a community preference in relation to the Central route option, identified as part of the most recent community consultation process conducted by GHD for Council. Notwithstanding the results of consultation, the preference of the community has not been a factor in selecting the preferred route in this part of the assessment.

20.1 Ranking Against the Project Objectives

Table 20.1 reiterates the ranking of the route options against the project objectives.

It is clear that the Northern Option is least beneficial in meeting the project objectives since the traffic modelling identifies that less people are likely to use the road the further north it is, and therefore the benefits to Illaroo Road would be less.

Generally the Southern Option has the least distances and times travelled and these metrics increase the further north the link road alignment is located. Whilst the Central route has slightly longer distances and overall network travel times compared with the Southern Option, the existing roundabout at the Princes Highway intersection with Narang Road (which would be retained for the Central Option) has better capacity to absorb traffic at the Highway end, compared with the new traffic signals that would otherwise be required for the Southern Option, and less direct impacts on existing collector roads in Bomaderry, leading to greater potential for traffic diversions to the Central Option in peak periods. This explains why the Central Option is a strong performer, showing a similar level of performance across all parameters when compared to the Southern Option.

Table 20-1: Ranking Against Project Objectives

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Project Objectives	6	6	12

Note: The lowest score is the best performing route option.

20.2 Ranking Against the Environmental Issues

In this assessment two different technical analyses have been carried out.

The first analysis is shown in **Table 20.2**. This aggregates the ranking for each of the issues described in Section 11 to Section 19. This means that every sub-indicator is treated equally.

This analysis means that issues with a larger amount of sub-indicators, such as traffic and biodiversity, have a more significant impact on the overall ranking. Inclusion of the ranking from the Environmental Risk Analysis results in some double counting, but reflects environmental risk associated with each option.

Table 20-2: Ranking Route Options Analysis 1

Parameter	Central Route Option	Southern Route Option	Northern Route Option	Total Weighting of Issues
Land Use Impacts	10	11	9	30 (9%)
Traffic Impacts	13	12	24	49 (14%)
Biodiversity Impacts	22	21	16	59 (17%)
Noise Impacts	6	9	7	22 (6%)
Aboriginal Heritage	2	5	4	11 (3%)
Soil and Water	4	5	7	20 (6%)
Economic	4	8	12	24 (7%)
Sub-Total Score	61	71	79	211 (62%)
Environmental Risk Analysis	41	48	41	130 (38%)
Total Score	102	119	120	341 (100%)

Note: The lowest score is the best performing route option.

The second analysis is shown in **Table 20.3**. This aggregates the rank for each of the issues described in Section 11 to Section 19. This means that the sub-indicator scores are not relevant only the actual ranking of each route option in total for each issue.

This analysis means that a large disparity between the route options on one issue does not have an overbearing impact on the overall ranking, but rather that even if a route option only performs slightly better or worse than another route option then this is treated equally. On this analysis there is not as large differentiation between the route options, however, the Central Option still performs better than the other two options.

Table 20-3: Ranking Route Options Analysis 2

Parameter	Central Route Option	Southern Route Option	Northern Route Option
Land Use Impacts	2	3	1
Traffic Impacts	2	1	3
Biodiversity Impacts	3	2	1
Noise Impacts	1	3	2
Aboriginal Heritage Impacts	1	3	2
Soil and Water	1	2	3
Economic	1	2	3
Sub-Total Score	**11**	**16**	**15**
Environmental Risk Analysis	1	3	1
Total Score	**12**	**19**	**16**

20.3 Selecting the Preferred Route

A new road link should provide a significantly improved level of access to / from the Princes Highway and should have the greatest potential to reduce traffic along the existing Illaroo Road. To not achieve these outcomes would be seen as a failure and waste of public funds.

Based on the analysis above the Central Option is the preferred option for the North Nowra Link Road. Overall it meets all the project objectives, ranks well on key and other issues, and has fewest adverse rankings. The key impact of biodiversity impacts on flora and fauna, and by extension impacts on the Regional Park, can be acceptably mitigated.

While the Southern Option would meet the overall project objectives and has similar overall biodiversity risks to Option 1, compared to Option 1 it:

- Has high capital costs and lower economic returns.
- Carries a higher environmental risk associated with contamination issues at the former landfill site.
- Requires more significant noise mitigation measures at eastern end.
- Involves acquisition of private property at both ends.
- Involves a direct connection to an existing Bomaderry collector road (West Bunberra Street) thereby increasing the risk of direct traffic impacts associated with the new link.
- Has more direct impact on the most pristine area of Bomaderry Creek Gorge walking track.

The Northern Option fails to meet all project objectives with limited benefits in terms of traffic effectiveness and a net negative benefit / cost ratio. It is unlikely that Council would be able to justify the capital expenditure in the construction of the Northern Option given the net negative benefit / cost ratio. Further, Council intends to build the Moss Vale Road to Illaroo Road Link which is in the same general vicinity of the Northern Option. In planning terms it makes little sense for Council to consider building both of these roads. Despite the perception that the Northern Option could utilise the existing West Cambewarra Road, investigations have shown this cannot be achieved due to adverse safety and amenity issues.

If neither the Central Option nor the Southern Option were approved as part of the Concept Plan then it is unlikely that Council would pursue the Northern Option because of the outcome of preliminary findings of the impacts of the Northern Option, the negative benefit / cost, and the limited traffic benefits in terms of resolving traffic congestion along the existing Illaroo Road in the short, medium and long terms. Future growth plans currently envisaged under the Nowra Bomaderry Structure Plan would also have to be reassessed and this may mean that the Illaroo Road to Moss Vale Road Link Road may be at risk of not proceeding.

In terms of addressing the short-medium term issues on Illaroo Road and at the Illaroo Road / Princes Highway Intersection, Council would continue to encourage the RTA to deliver the River Crossing Relief scheme and would carry out works along Illaroo Road on a needs basis to try and address the amount of accidents occurring along Illaroo Road, noting that any treatments are likely to add further delay to motorists and would not address the underlying problems associated with high traffic volumes, poor levels of safety and amenity conditions, and the associated ongoing costs to the community.

The North Nowra Link Road is justified and Option 1 (the Central Option) is considered to be the preferred route following an extensive objective analysis of the complete range of known factors and comparing the available options in detail.

21.0 Revocation of Land from the Bomaderry Creek Regional Park

All options would require the clearing of vegetation and revocation of land from the Bomaderry Creek Regional Park.

The biodiversity and recreational values of the Bomaderry Creek Regional Park are described in Section 6.1 of this report.

21.1 Legal Status of the Bomaderry Creek Regional Park

This Regional Park was dedicated through publication in the Government gazette in December 2002 under Section 30H of the *National Parks and Wildlife Act 1974* (NPW Act).

Section 30H of the NPW Act states:

(1) The purpose of reserving land as a Regional Park is to identify, protect and conserve areas in a natural or modified landscape that are suitable for public recreation and enjoyment so as to enable those areas to be managed in accordance with subsection (2).

(2) A Regional Park is to be managed in accordance with the following principles:

- *(a) the provision of opportunities, in an outdoor setting, for recreation and enjoyment in natural or modified landscapes,*
- *(b) the identification, interpretation, management and conservation of the park so as to maintain and enhance significant landscape values,*
- *(c) the conservation of natural and cultural values,*
- *(d) the promotion of public appreciation and understanding of the Regional Park's natural and cultural values,*
- *(e) provision for sustainable visitor use and enjoyment that is compatible with the conservation of the Regional Park's natural and cultural values,*
- *(f) provision for the sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to the conservation of the Regional Park's natural and cultural values,*
- *(g) provision for the carrying out of development in any part of a special area (within the meaning of the Hunter Water Act 1991) in the Regional Park that is permitted under section 185A having regard to the conservation of the Regional Park's natural and cultural values."*

Section 39 of the NPW Act states:

(1) In this section, existing interest means any authority, authorisation, permit, lease, licence or occupancy.

(2) Except as provided in this Act, the reservation of lands as, or as part of, a national park or historic site does not affect:

- *(a) the terms and conditions of any existing interest in respect of those lands from the Crown or the trustees, current and in force at the time of the reservation, or*
- *(b) the use permitted of those lands under the interest.*

Section 47U of the NPW Act states that:

(1) A Regional Park trust may, with the written consent of the Director-General (and subject to any conditions imposed in giving that consent):
(a) grant leases of land in the Regional Park, and
(b) grant licences to occupy or use land in the Regional Park, and
(c) purchase or take a lease of any land (whether or not adjoining the Regional Park) required for use in connection with the area.

(2) If the Director-General has the care, control and management of the Regional Park, the Director-General may grant any such leases or licences.

Section 47Z of the NPW Act states:

(1) Despite anything in this or any other Act, land within a Regional Park is not to be dealt with except as provided under this Act.

47ZB of the NPW Act states:

(1) Despite anything in this or any other Act:
(a) the reservation of land as (or as part of) a Regional Park is not to be revoked, and
(b) land within a Regional Park is not to be appropriated or resumed, except by an Act of Parliament.

The effect of the above provisions of the NPW Act is to:

- Establish the management regime for the Regional Park. The proposed North Nowra Link Road would cross land that is currently dedicated as a Regional Park. The proposed road would not be consistent with the management objectives described in Section 30H of the NPW Act.
- Permit the continued occupancy or use in the Regional Park. The existing services corridor would be able to be maintained under Section 39 of the NPW Act since it was a land use which was in place at the time the Regional Park was dedicated.
- Ensure that the land within the Regional Park is dealt with under the provisions of the NPW Act. The provisions of the *Environmental Planning and Assessment Act 1979*, and the provisions of any environmental planning instruments made under that Act, are not relevant in determining the permissibility of use within the Regional Park.
- Permits the Director-General of Department of the Environment, Climate Change and Water (DECCW) to grant a lease or a licence for occupation or use of land within the Regional Park. It is DECCW policy not to authorise by the granting of a lease or a licence for the use of land within the Regional Park for the purposes of a new road.
- Require that land can only be resumed or revoked from a Regional Park by an Act of Parliament. For the proposed North Nowra Link Road to proceed, revocation of the proposed route corridor from within the Bomaderry Creek Regional Park would be required.

DECCW is responsible for the administration of the NPW Act and the management of the Bomaderry Creek Regional Park. DECCW have developed a guideline which sets out the procedures and considerations for the revocation of land from a Regional Park, the NSW *Revocation of Land Policy*.

The following sections of the EAR set out how the relevant provisions of the NSW Revocation of Land Policy have been applied and where necessary the relevant considerations addressed.

21.2 The Revocation of Land Policy

The relevant provisions of DECCW's Revocation of Land Policy are:

(1) The revocation of lands reserved or dedicated under the NPW Act will generally be undertaken as an avenue of last resort and only where appropriate, for example to correct a boundary error or encroachment where no other practical options are available.

(9) Where a non-permissible activity or development (e.g. a major highway rerouting or upgrade) is proposed by another party and requires the use of NPWS land, either the park boundary can be re-defined to exclude the proposed development or the development cannot proceed because it would encroach upon the park.

(10) In exceptional circumstances and where no suitable alternative sites are available outside of NPWS land, the Minister (only) may direct the NPWS to examine the potential revocation of the area. Circumstances where this may be required may include major Government infrastructure initiatives.

(11) In such circumstances, the proponent is to provide the Director-General and the Minister with details regarding the proposal, including any land proposed as compensation. The proponent is required to demonstrate to the Director-General, and ultimately the Minister, that the revocation is essential and that the public value of the proposed activity outweighs any conservation loss.

(13) In providing advice to the Minister regarding development proposals that would require revocation, factors that should be considered include (but are not limited to):

- Any formal advice or resolutions prepared by the National Parks and Wildlife Advisory Council and relevant Advisory Committee;
- Positive or negative impacts (if any) on the integrity of the park and its boundaries (including connectivity and manageability);
- Positive or negative impacts (if any) on the natural and cultural values of the park;
- Positive or negative impacts (if any) on current and future visitors to the park (including access and amenity);
- Adequacy of proposed compensation for the revocation; and
- Social, economic and financial costs and benefits of any action with respect to the proposed development.

(15) Where the NPWS seeks compensation for revocations, it will generally be in the form of the transfer of land to the Minister for reservation or dedication under the NPW Act (and preferably as an addition to the park that is subject to the revocation).

(17) When negotiating compensation, the NPWS will be guided by the following heads of consideration:

(a) Compensatory land should be of greater size than the area of land being revoked (and at least of equal size);

(b) It is desirable to match the area, type and quality of habitat, and cultural heritage on land being revoked with the area of land proposed as compensation where possible. Exceptions to this may include, for example, compensation that includes a different habitat type (e.g. That is poorly reserved) where the habitat to be impacted is commonly represented within the relevant park;

(c) It is desirable that land to be transferred as compensation is close to the area being revoked and is adjacent to the relevant reserve; and

(d) Information gathered on lands to be revoked and on proposed compensatory land should include:
- Biodiversity, e.g. species present, including populations and community presence, and habitat types;
- An assessment of habitat quality, habitat connectivity, and adjoining habitat uses;
- The home range and territories of target species,
- Rarity of species;
- Landform; and
- Cultural heritage values.

(18) For all revocations requiring compensation, a written agreement is to be made between the Minister and the party to whom the Minister will transfer the revoked land prior to the introduction of revocation legislation. This agreement shall identify the proposed compensation and its natural and/or cultural heritage values and will ensure the transfer of the compensation to the Minister. An agreement may occur through the exchange of letters between both parties.

(19) The Minister must be satisfied that proposed compensation is of equal or greater conservation value both in terms of natural and cultural heritage than the land that is proposed to be revoked.

(20) It is desirable that compensatory land is transferred to the Minister prior to, or simultaneously with, the transfer of the revoked land.

There are 2 key matters for consideration and assessment.

- The first is to assess the project against clause 1 of the Revocation of Land Policy. This requires that the proponent demonstrate that the project represents the avenue of last resort and that no other practical options are available. This is provided in Section 21.3 below.
- The second is an assessment against the factors that should be considered as described in clause 13 of the Revocation of Land Policy. This is provided in Section 21.4 below.

21.3 Revocation of Land Policy – Clause 1

The Revocation of Land Policy requires that the project represents the avenue of last resort and that no other practical options are available. This consideration has been made for the North Nowra Link Road concept (i.e. all three route options considered as a single concept).

21.3.1 Growth in North Nowra

Section 2 of this report describes the growth demands that are being experienced within the Shoalhaven region, and the approach taken by the NSW Government and Shoalhaven City Council's in meeting these growth demands. The NSW Government's approach is set out in the South Coast Regional Strategy and Council's approach is set out in the Nowra Bomaderry Structure Plan which have been endorsed by the NSW Government.

To meet the growth expectations for Nowra-Bomaderry Council has identified a suite of growth scenarios, and locations where growth can be accommodated, using a range of new greenfield development areas and increased density (i.e. 'in-fill development') within existing residential areas. North Nowra has been identified for both increased density development and for the location of one of the key greenfield development areas.

21.3.2 Existing Constraints on the Traffic Network

Section 4 of this report describes the existing constraints within the local and regional road network. The critical constraint is the bridges crossing the Shoalhaven River, which are projected to reach capacity by 2016. The congestion on the Princes Highway results in congestion on local feeder roads. Of particular concern to Council is the significant congestion and large number of accidents occurring on Illaroo Road and at the intersection between Illaroo Road and the Princes Highway.

It is highlighted that projected growth in Nowra-Bomaderry will exacerbate the existing constraints, and the North Nowra Link Road is a key proposed transport link in meeting the projected growth in North Nowra and meeting the objectives of the NSW Government's South Coast Regional Strategy.

21.3.3 Options for Alleviating Traffic Congestion

Because a large proportion of the traffic using the Princes Highway bridges and the impact that congestion on the Princes Highway has on the surrounding local road network Council has worked with the RTA over several years to investigate options for addressing the traffic constraints. This has included several options for new bridge crossings, improved bridge crossings and the feasibility of grade-separated interchanges along the Princes Highway.

The bridges crossing the Shoalhaven River are part of the Princes Highway, which is a State funded and managed highway. At this stage Council is not aware of any intention by the RTA or the NSW State Government to invest in significant improvements to the Princes Highway in the vicinity of the Shoalhaven River bridge crossings, or to construct a new bypass for Nowra.

As such, until the RTA selects a preferred option for improvements to the Princes Highway, and secures funding for the improvements, options associated with upgrading the Princes Highway, and its intersections, including the Shoalhaven River bridges, are unfeasible and impractical.

21.3.4 Council Options for Alleviating Traffic Congestion

Because there are no practical or feasible options available to Council for upgrading the Princes Highway and its intersections, Council has 2 options:

- Do the minimum
- Supplement the existing local road network.

The minimum action that can be taken by Council will be to make minor safety improvements to the intersections along Illaroo Road in an attempt to minimise accident rates as traffic congestion worsens. This would include carrying out works along Illaroo Road on a needs basis to try and address the amount of accidents occurring along Illaroo Road, noting that any treatments are likely to add further delay to motorists and would not address the underlying problems associated with high traffic volumes, poor levels of safety and amenity conditions, and the associated on-going costs to the community. This is not considered to be an optimum solution and will not accommodate the predicted growth in North Nowra, as envisaged in the Nowra-Bomaderry Structure Plan.

Based on the above analysis this report demonstrates that there are no practical and feasible options for alleviating the traffic constraints that have been identified in traffic models and realised through observation of the increasingly severe congestion along Illaroo Road and at the Illaroo Road / Princes Highway intersection.

Council have therefore progressed investigations for alleviating the existing congestion and high accident levels on Illaroo Road and at the Illaroo Road / Princes Highway intersection by supplementing the local road network.

A long list of options was developed by Council to supplement the local road network, including investigating the traffic benefits associated with early construction of the Moss Vale Road Link, which would connect Illaroo Road north to Moss Vale Road.

Because of the nature of the traffic constraints and the location of the Regional Park only a small number of possible North Nowra Link Road options are outside of the Regional Park. These are:

- The Jamieson Road to Turley Road connection
- The Moss Vale Road Link connection

21.3.5 Jamieson Road to Turley Road Option

The alignment for this option is dictated by the very wide nature of the Bomaderry Creek Gorge and the shape of Bomaderry Creek. The alignment would need to swing north immediately at the eastern end of Jamieson Road then swing back south along steep spur crossing of the gorge in vicinity of Turley Avenue, creating a very long alignment with large costs associated with the bridge structure.

This option was found to be unacceptable in terms of:

- Sub standard horizontal and vertical alignment that could be obtained due to the complex topographical constraints through this area.
- The direct impacts on existing residential areas along Jamieson Road and Turley Avenue especially considering there would be no possibility of retaining Jamieson Road as a local access road, and so requiring multiple private accesses to the new link road.
- The likely requirement to widen both Turley Road and Jamieson Road, with direct impacts to many private properties and significant associated costs.

This option was therefore rejected as being unfeasible and impractical.

21.3.6 Moss Vale Road Link Option

The most northerly option considered. This link forms part of the preferred road network of the NBSP to allow good level of local accessibility between the existing residential areas in North Nowra and the residential land expansion areas on the southern side of Moss Vale Road and to limit the need for new area traffic generation to rely on access to the State road network alone.

In this strategic context this new Moss Vale Link Road is part of the long term planning which has the potential to further mitigate traffic volumes on Illaroo Road with specific regard to the future expansion of North Nowra.

The provisional TRACKS screening analysis showed that this option was consistently the worst performing option considered. The key points in the traffic network are the Illaroo Road Princes Highway intersection and extending approximately 2.5 km along Illaroo Road up to the Pitt Street intersection. With consideration of these key connecting points on the network it is clearly unlikely that the Moss Vale Road Link, which is northerly focussed, will be able to achieve the project objectives in terms of providing a suitably attractive alternative to using Illaroo Road / Princes Highway intersection for journeys between North Nowra and Bomaderry and for journeys between North Nowra and Nowra City Centre.

This option is therefore not considered able to provide short-medium term relief of existing problems, and is therefore neither feasible not practical.

21.3.7 Practical and Feasible Options within the Regional Park

The North Nowra Link Road concept, involving the revocation of land from the Bomaderry Creek Regional Park, is therefore seen as the only feasible and practical solution for Council.

The following section justifies the level of revocation for each option and describes the proposed off-sets.

21.4 The North Nowra Link Road Concept

The amount of vegetation to be cleared within the Regional Park, which approximates the amount of land that would need to be revoked, is listed below:

- Option 1: Central Option 1.6 ha
- Option 2: Southern Option 0.3 ha
- Option 3: Northern Option 0.9 ha

All three options are likely to result in varying degrees of fragmentation and edge effects.

21.4.1 Option 1: The Central Option

Positive or negative impacts on the integrity of the park and its boundaries (including connectivity and manageability)
Option 1 will impact on the connectivity between two sections of Regional Park. It enhances the existing barrier between habitats to the south from the habitat in the north.

The potential connectivity impacts associated with Option 1 have been assessed for each relevant threatened species in Section 13. Mitigation measures have been proposed to minimise the connectivity impacts associated with the road for threatened fauna species, including the provision of overpasses for arboreal species in the form of rope bridges or gliding poles.

The assessment concluded that the habitat connectivity issues were considered to be minimal and insignificant, partly because the route option follows the general alignment of a cleared services and transmission line corridor which already affects habitat connectivity within the Regional Park.

The proposed off-sets would add significantly to the extent of the Regional Park, significantly enhancing its integrity, extending its boundaries, and improving connectivity between habitats that are currently partially contained within the Regional Park and partially outside of the Regional Park on Council owned land.

It is considered that manageability of the park would be improved because of improved surveillance by passing traffic of parts of the Park. In particular, the current behaviour near and inside the Bomaderry Creek Regional Park is aggravated by a lack of supervision and exposure to other people using the area. There have been a number of dumped cars along the alignment for the Central Option because there is currently good access provided by the existing transmission line and water pipeline service road. Increased surveillance of passing traffic and appropriately placed traffic barriers will curtail anti-social behaviour in this section of the Regional Park.

Positive or negative impacts on the natural and cultural values of the park
The Bomaderry Creek Regional Park has high biodiversity values and contains suitable habitat for a number of threatened flora and fauna species. The Park is also of significant importance for its natural heritage, Aboriginal spiritual connection and contemporary European heritage in reference to the Bomaderry Creek Weir.

Revocation of part of the Regional Park for the Central Option would not significantly impact on the natural or cultural values of the Regional Park. This is because most of the area to be revoked is immediately adjacent to, or part of, an existing services corridor which is in an infrequently visited part of the Regional Park.

The Central Option includes the construction of a bridge in the same general location as where the water pipeline and electricity transmission line crosses Bomaderry Creek. The bridge and road will impact on the setting and context of the Bomaderry Creek Weir however this is already affected by the water pipeline bridge. It will also affect the amenity of people using the walking trails to access the weir, however, it will also facilitate better access and opportunities to view and interpret the weir and its associated infrastructure allowing the community to better understand and appreciate the region's historical connection with the weir.

The proposed off-sets would enhance significantly the natural and cultural values of the Regional Park, by extending the walking trails which start and finish in the Regional Park but which pass outside of the Regional Park for significant distances, so that they are entirely within the Regional Park.

Positive or negative impacts on current and future visitors to the park (including access and amenity)
The principle loss of amenity would relate to increased traffic noise and visual impact from the road and bridge structure in the vicinity of the Bomaderry Creek Weir, although the road would improve the awareness of the park and the weir, and the existing water pipeline crossing already makes a visual amenity intrusion to the locality.

The Central Option will create a barrier between recreational walking trails to the south and the north. These impacts on the walking trails within the Regional Park would include:

- Modifications to the walking trails on the east side of Bomaderry Creek, (which provides access from the Park entrance and facilities area down to the Bomaderry Creek Weir), to minimise the reduction of amenity for visitors on the walking track.
- The walking trail for Bernies Lookout starts within the Regional Park grounds, and would be required to be modified as part of the Central Option to maintain the trail.
- The walking trail which connects the other walking trails along Bomaderry Creek with west Cambewarra Road, would be severed by the Central Option and would need to be modified to provide an alternative connection.

Council would address impacts to walking trails by modifying or relocating the trails to accommodate the road and bridge for the Central Option. This would include ensuring that the Bernies Lookout trail can pass underneath the proposed bridge for the Central Option.

The location of the North Nowra Link Road on the Central Option would provide for improved awareness of the Regional Park and its facilities.

Adequacy of proposed compensation for the revocation
Up to a maximum of 50 ha of Council owned land will be dedicated, subject to future agreement with DECCW, including land described as follows: part of Lot 109 DP 3060, part of Lot 108 DP 131063, Lot 27 and 28 DP 130999, Lot 28, Lot 2 DP 817278 and part of Lot 119 DP 751258. The quantity of proposed compensation is more than 25 times the amount of Regional Park which is requested to be revoked.

The value of these parcels of land are described in detail in The Revocation and Off-sets Report, which is Appendix E of the Biodiversity Report prepared by Eco Logical, and provided as **Appendix F** to the EAR.

The offset land for the proposed North Nowra Link Road is immediately adjacent and congruent with the Bomaderry Creek Regional Park. The proposed offset land is located on the northern side of the Shoalhaven River and to the west of the Princes Highway and is intersected by Bomaderry Creek, which runs from the north to the south-east of the offset land. The offset land occurs within three parcels, of 4 hectares, 18 hectares and 28 hectares, and is located to the north, east and south of the Bomaderry Creek Regional Park. The offset land is located on both sides of the Bomaderry Creek gorge and includes a substantial length of the Gorge and the Creek. Addition of the offset lands would significantly improve the functional and recreational amenity of the Regional Park by ensuring that the full length of walking trails through the Bomaderry Creek Gorge are located within the Regional Park.

Strong habitat connectivity is achieved when combining the offset area with Bomaderry Creek Regional Park as the vegetation is contiguous with the park along its eastern, northern, and southern edges. The offset area contributes an additional 50 ha to Bomaderry Creek Regional Park and expands the park from 82 ha to 132 ha.

In addition, the offset parcels include a substantial part of Bomaderry Creek which encompass both sides of the gorge and their dedication to the park will expand protection of this riparian corridor. The vegetation present along most of Bomaderry Creek was considered high quality and supports fauna movement along the length of this corridor and is likely to be used by some fauna species for visitation, foraging, and breeding. Off-set lands to the north of the Regional Park also support high quality vegetation and inclusion of these parcels to the northern boundary of the park will protect habitat connectivity in this area and facilitate fauna movement.

No signs of significant fragmentation or large cleared areas were identified within the offset area. Fauna movement is possible throughout the offset area and within Bomaderry Creek Regional Park. The vegetation within the offset parcel has high connectivity value in an urban area in which little other native vegetation persists.

The value of the offset lands includes:

- All four of the vegetation communities where *Zieria baeuerlenii* are found are part of the offset lands increasing the potential habitat for this species within the Regional Park.
- increasing known colonies of *Zieria baeuerlenii* in the Regional Park from 60% to 97%;
- increasing known genotypes of *Zieria baeuerlenii* within the Regional Park from 60% to 100%; and
- increasing critical habitat for *Zieria baeuerlenii* within the Regional Park from 51% to 88%.

- All remaining land identified as potential habitat for the Giant Burrowing Frog will be contained within the offset lands.
- A considerable amount of suitable habitat for Yellow-bellied Gliders.
- Increased habitat for many threatened species under DECCW tenure and management.

Social, economic and financial costs and benefits of any action with respect to the proposed development
Diverting traffic away from Illaroo Road to the Link Road could be significant in reducing the number of accidents on Illaroo Road. Similarly, diversion of this traffic may defer the need to upgrade Illaroo Road intersections.

AECOM also confirmed that if a link road is not constructed to relieve traffic on Illaroo Road, safety conditions are likely to worsen due to continual traffic growth and deteriorating environmental amenity. A Link Road would enhance public enjoyment and encourage recreational activity by giving easier access to facilities in the Regional Park. Those facilities include the car park and picnic areas, walking tracks and educational displays.

The connectivity gains to the community would potentially deliver cheaper and greater access to nearby community and private infrastructure. A link road would afford better vehicular entry and exit for emergency service vehicles, and escape routes during emergencies, fires and hazard reduction operations.

A detailed social-economic assessment (Section 18) of the three NNLR route opp[tions determined that Option 1 was the preferred route with the overall best social, economic outcomes.

21.4.2 Option 2: The Southern Option

Positive or negative impacts on the integrity of the park and its boundaries (including connectivity and manageability)
Option 2 will not impact on the connectivity or manageability of the park. It will impact on the southern boundary of the Regional Park which is already affected by the presence of the closed Council landfill.

Option 2 was specifically designed and assessed as part of the Concept Plan because of its minimal impacts to the Regional Park.

Option 2 will, however, impact on the Council land immediately adjacent to the Regional Park, on the eastern side, which includes the walking trails that connect to the walking trails within the Regional Park.

Positive or negative impacts on the natural and cultural values of the park
Revocation of part of the Regional Park for the Southern Option would not significantly impact on the natural or cultural values of the Regional Park. This is because the area to be revoked is in an infrequently visited part of the Regional Park well away from walking trails, which is already affected by the presence of the closed Council landfill.

Positive or negative impacts on current and future visitors to the park (including access and amenity)
Revocation of part of the Regional Park for the Southern Option would not impact on current or future visitors to the Regional Park. This is because the area to be revoked is in an infrequently visited part of the Regional Park well away from walking trails, which is already affected by the presence of the closed Council landfill.

Option 2 will, however, impact on the Council land immediately adjacent to the Regional Park, on the eastern side, which includes the walking trails that connect to the walking trails within the Regional Park.

Adequacy of proposed compensation for the revocation
Up to a maximum of 12 ha of Council owned land will be dedicated subject to future agreement with DECCW, including land described as Lot 27 DP 130999, which is located to the east of the north eastern section of the Regional Park.

The offset land for the proposed North Nowra Link Road is immediately adjacent to the Bomaderry Creek Regional Park, located on both sides of the Bomaderry Creek Gorge and includes a substantial length of the Gorge and the Creek. Addition of the offset lands would significantly improve the functional and recreational amenity of the Regional Park by increasing the length of Bomaderry Creek walking trails located within the Regional Park.

The value of these parcels of land are described in detail in The Revocation and Off-sets Report, which is Appendix E of the Biodiversity Report prepared by Eco Logical, and provided as **Appendix F** to the EAR.

The proposed offset parcels contain significant high quality habitat for threatened fauna and flora, especially for threatened owl and bat species, known foraging areas for the Yellow-bellied Glider and Glossy Black-cockatoo, and potential migratory species.

The dense riparian vegetation is considered high quality and supports large hollow-bearing trees which are potentially used by threatened owls. Some disturbances were noted but generally overall disturbance levels were considered low. The cliffs also provide potential roosting sites for bat species. This parcel will be a valuable inclusion within Bomaderry Creek Regional Park as it includes Bomaderry Creek and supports high quality vegetation. This parcel also secures land that acts as a vegetative buffer to nearby residential housing.

Social, economic and financial costs and benefits of any action with respect to the proposed development
Diverting traffic away from Illaroo Road to the Link Road could be significant in reducing the number of accidents on Illaroo Road. Similarly, diversion of this traffic may defer the need to upgrade Illaroo Road intersections.

AECOM also confirmed that if a link road is not constructed to relieve traffic on Illaroo Road, safety conditions are likely to worsen due to continual traffic growth and deteriorating environmental amenity.

The connectivity gains to the community would potentially deliver cheaper and greater access to nearby community and private infrastructure. A link road would afford better vehicular entry and exit for emergency service vehicles, and escape routes during emergencies, fires and hazard reduction operations.

21.4.3 Option 3: The Northern Option

Positive or negative impacts on the integrity of the park and its boundaries (including connectivity and manageability)
Option 3 will not impact on the connectivity or manageability of the park. It will impact on the northern boundary of the Regional Park which is already affected by its proximity to West Cambewarra Road and residential development.

Option 2 was specifically designed and assessed as part of the Concept Plan because of its minimal impacts to the Regional Park.

Positive or negative impacts on the natural and cultural values of the park
Revocation of part of the Regional Park for the Northern Option would not significantly impact on the natural or cultural values of the Regional Park. This is because the area to be revoked is in an infrequently visited part of the Regional Park well away from walking trails, which is already affected by its proximity to West Cambewarra Road and residential development.

Positive or negative impacts on current and future visitors to the park (including access and amenity)
Revocation of part of the Regional Park for the Northern Option would not impact on current or future visitors to the Regional Park. This is because the area to be revoked is in an infrequently visited part of the Regional Park well away from walking trails, which is already affected by its proximity to West Cambewarra Road and residential development.

Adequacy of proposed compensation for the revocation
Up to a maximum of 17 ha of Council owned land will be dedicated, subject to future agreement with DECCW, including land described as follows: part of Lot 109 DP 3060 and part of Lot 108 DP 131063.

The offset land for the proposed North Nowra Link Road is located immediately adjacent to the northern boundary of Bomaderry Creek Regional Park and includes a small section of Bomaderry Creek. The Bomaderry Creek Lookout (Bernies Lookout) is also included within this parcel and provides an avenue to educate park visitors on the high biodiversity value of the area.

The value of these parcels of land are described in detail in The Revocation and Off-sets Report, which is Appendix E of the Biodiversity Report prepared by Eco Logical, and provided as **Appendix F** to the EAR.

The proposed offset lands support significant high quality habitat for threatened fauna and flora, especially known foraging areas for the Yellow-bellied Glider and Glossy Black-cockatoo and for Bomaderry Zieria and Albatross Mallee habitat. Potential Giant Burrowing Frog breeding habitat has been identified within this parcel.

Some disturbance was noted within the area, but generally overall disturbance levels were considered low. Due to the low disturbance levels and the presence of high quality vegetation this parcel will be a valuable inclusion within Bomaderry Creek Regional Park.

Social, economic and financial costs and benefits of any action with respect to the proposed development
Diverting traffic away from Illaroo Road to the Link Road could be significant in reducing the number of accidents on Illaroo Road. Similarly, diversion of this traffic may defer the need to upgrade Illaroo Road intersections.

AECOM also confirmed that if a link road is not constructed to relieve traffic on Illaroo Road, safety conditions are likely to worsen due to continual traffic growth and deteriorating environmental amenity.

The connectivity gains to the community would potentially deliver cheaper and greater access to nearby community and private infrastructure. A link road would afford better vehicular entry and exit for emergency service vehicles, and escape routes during emergencies, fires and hazard reduction operations.

Notwithstanding this, the socio-economic assessment (see Section 18) identified a net negative economic benefit from the Northern Option.

22.0 Draft Statement of Commitments

In accordance with the Director-General's Environmental Assessment Requirements, the proponent is required to include a Draft Statement of Commitments in respect of environmental management and mitigation measures for the project. The draft Statement of Commitments made by Shoalhaven Council to manage and minimise potential impacts arising from the Concept Plan are provided in **Appendix K**. The key commitments are discussed further below.

22.1 Biodiversity Offsets

The project will require the revocation of land from the Bomaderry Creek Regional Park which will require the bringing of a bill before the NSW Parliament to authorise the proposed revocation.

Shoalhaven City Council will enter into an agreement with the Department of Environment, Climate Change and Water for the dedication of Council owned lands to be incorporated into the Bomaderry Creek Regional Park.

The amount of land to be dedicated will be dependent on the option built and the actual amount of vegetation that will be required to be cleared from within the Regional Park resulting from the detailed design, however will be generally consistent with the following provision:

- Option 1: Central Route

Up to a maximum of 50 ha of Council owned land will be dedicated, subject to further agreement with DECCW, including land described as follows: part of Lot 109 DP 3060, part of Lot 108 DP 131063, Lot 27 and 28 DP 130999, Lot 28, Lot 2 DP 817278 and part of Lot 119 DP 751258, which is located adjacent to the northern and eastern boundaries of the Regional Park.

- Option 2: Southern Route

Up to a maximum of 12 ha of Council owned land will be dedicated, subject to further agreement with DECCW, including land described as Lot 27 DP 130999, which is located adjacent to the eastern boundary of the north-eastern part of the Regional Park.

- Option 3: Northern Route

Up to a maximum of 17 ha of Council owned land will be dedicated, subject to further agreement with DECCW, including land described as follows: part of Lot 109 DP 3060, part of Lot 108 DP 131063, Lot 27 and 28 DP 130999, Lot 28, and part of Lot 119 DP 751258, which is located adjacent to the northern boundary of the Regional Park.

22.2 Biodiversity Mitigation

Design Stage Mitigation Measures

- Detailed design will minimise the area of native vegetation to be cleared wherever reasonable and feasible.
- The road will be designed to minimise direct impacts to threatened species. In particular fauna underpasses or overpasses (e.g. gliding poles or rope bridges) would be included in the design, where appropriate, to provide habitat connectivity for threatened fauna species. The road will also be designed to minimise the possibility of roadkill events through lighting, signage and pavement materials. Bridge design will maximise movement of terrestrial and aquatic species.

Construction Stage Mitigation Measures

Measures during construction work to protect vegetation and threatened flora species will include:

- Education of the construction workforce.
- Prior to clearing of vegetation all trees and vegetation outside of the immediate construction and clearing zone will be protected by fencing from unauthorised access during the construction period.
- During the construction of the road nearby threatened flora specimen will be fenced off prior to construction and clearly marked as "no-go" areas. Specific management measures to ensure minimal impact to individual specimen will be detailed in the Construction Environmental Management Plan.

Measures during construction work to protect threatened fauna species will include:

- Pre-clearing surveys of tree hollows.
- Timing of clearing to avoid high rainfall periods & high bushfire risk periods.
- Clearing methods to minimise impacts to adjacent habitats
- Education of the construction workforce.

Operation Stage Mitigation Measures

Operational measures to protect threatened flora species will include:

- Specimen of threatened flora species nearby to the central road corridor will be permanently fenced in the vicinity of the road and minimal stopping areas will be provided along the road and reinforced through the use of fauna permeable fencing along the roadside.
- Road verge management will be undertaken in such a way as to maintain low fuel loads to reduce the risks of incidental fires, minimise the potential impacts of weeds, maintain or replace shade trees and will include erosion and sediment control measures. Council will also support species propagation efforts for the *Zieria Bauerlenii*.

22.3 Noise Mitigation

Noise berms or walls would be designed as part of the detailed design of the road to ensure compliance with the NSW EPA's Environmental Criteria for Road Traffic Noise. Further noise assessment would be carried out on the detailed road design, incorporating the noise berm or wall, when the final road alignment and pavement elevation are determined.

23.0 Project Justification

The anticipated benefits of a North Nowra Link Road are described below.

- Improve travel times and reduce congestion on Illaroo Road

  The Southern and Central Options result in substantial reduction in overall network VHT which represents overall improvement to network efficiency and lower overall emissions and therefore less pollution levels. This provides considerable benefits to the environment and the local community.

  Traffic Modelling shows that during peak periods there would be up to 30% reduction in traffic on Illaroo Road following construction of a link road. This results in travel times savings and queue reduction for vehicles using Illaroo Road and reduces overall average delays at the Princes Highway / Illaroo Road intersection.

  In the critical peak periods travel time benefits are constrained due to the high proportion of traffic with a destination south of the river and the congestion on the Princes Highway at the Shoalhaven River bridges. However, apart from improvements to the existing travel route along Illaroo Road there will be a significant improvement in travel time for those 30% of motorists that do not have a destination south of the river but who are usually caught up in the congestion on Illaroo Road (including at the intersection of Illaroo Road and the Princes Highway). This represents a significant increase in transport efficiency and accessibility for traffic into/out of North Nowra.

  In congested peak periods often a better indicator of improvement in network efficiency is the VHT parameter, and as indicated in Table 12-1 both the Central and Southern Option would provide marked travel time savings network wide.

  Improved travel times into / out of North Nowra and reduction in overall VHT converts to considerable on-going travel time cost savings to the community. The connectivity gains would provide access improvements to North Nowra and between North Nowra and the Princes Highway and Bomaderry for residences and businesses alike.

- Improve safety and amenity on Illaroo Road.

  The link road would be designed to meet current construction and safety standards, providing a higher standard route for traffic into / out of North Nowra with improved capacity for movements.

  The diversion of traffic from Illaroo Road on to the Link Road is likely to reduce accident rates on Illaroo Road, and will defer the need for upgrading Illaroo Road intersections, such as introducing additional signals at key intersections along Illaroo Road. Installation of traffic signals or any other treatment that would allocate priority to side roads and pedestrians would have the undesirable and compounding adverse effect of further delays to traffic on Illaroo Road.

  Quantifying the likely rate for reduction of accidents or change in accident types as a result of a new link road is difficult to determine at this stage, as is the need to introduce future road safety upgrades on Illaroo Road. However, it is clear that if the Link Road is not constructed to relieve traffic conditions on Illaroo Road, safety conditions are likely to deteriorate as a result of continual traffic growth.

In fact it is likely that safety conditions will deteriorate even if there is no additional growth in North Nowra, as demonstrated by the traffic modelling of this scenario which showed significant lengthening of queues along Illaroo Road due to increased proportion of green time allocated to Highway traffic over time to address congestion at the bridges. The NNLR therefore will provide marked safety improvements irrespective of the growth scenario.

Approximately 60% of all accidents along Illaroo Road have occurred where no traffic controls exist. Reduction in traffic volumes on Illaroo Road by implementation of the proposed North Nowra Link Road could be significant in reducing the number of accidents on Illaroo Road where no traffic controls exist, and will defer the need for upgrading Illaroo Road intersections.

Apart from network efficiency and safety benefits, the shift in up to 30% traffic from Illaroo Road to the NNLR will provide considerable benefit to residents along Illaroo Road, addressing the underlying problems associated with high traffic volumes, including poor levels of safety, and amenity conditions impacting residents of Illaroo Road on a daily basis.

- Delivers on key infrastructure provided for within the Nowra-Bomaderry Structure Plan.
- Is complimentary to all options under consideration by the RTA for improvements to the Princes Highway, and can therefore enhance any benefits of RTA upgrade works on the Princes Highway to extend the life of the existing Shoalhaven River crossings.

  The Central Option (Option 1) is particularly complimentary to the Princes Highway given that there is an existing under utilised roundabout at the intersection of Princes Highway / Narang Road that was built as apart of the Highway upgrade through Bomaderry among other reasons to accommodate the proposed NNLR.
- Provides North Nowra with a second access for emergency services, particularly critical during peak periods when substantial queuing on Illaroo Road currently creates obstruction and unsatisfactory delays to emergency service vehicles.

Based on a detailed analysis of the three route options the Central Option is the preferred option for the North Nowra Link Road. Overall it meets all the project objectives, ranks well on key and other issues, and has fewest adverse rankings. The key impact of impacts on flora and fauna, and impacts on the Regional Park, can be acceptably mitigated through the implementation of appropriate design measures.

While the Southern Option would meet the overall project objectives and has similar overall biodiversity risks to Option 1, compared to Option 1 it:

- Has high capital costs and lower economic returns.
- Carries a higher environmental risk associated with contamination issues at the former landfill site.
- Requires more significant noise mitigation measures at eastern end.
- Involves acquisition of private property at both ends.
- Involves a direct connection to an existing Bomaderry collector road (West Bunberra Street) thereby increasing the risk of direct traffic impacts associated with the new link.
- Has more direct impact on the most pristine area of Bomaderry Creek Gorge walking track.

The Northern Option fails to meet all project objectives with limited benefits in terms of traffic effectiveness and a net negative benefit / cost ratio. It is unlikely that Council would be able to justify the capital expenditure in the construction of the Northern Option given the net negative benefit / cost ratio.

Further, Council intends to build the Moss Vale Road to Illaroo Road Link which is in the same general vicinity of the Northern Option. In planning terms it makes little sense for Council to consider building both of these roads. Despite the perception that the Northern route could utilise the existing West Cambewarra Road, investigations have shown this cannot be achieved due to adverse safety and amenity issues.

If neither the Central Option nor the Southern Option were approved as part of the Concept Plan then Council would be unlikely to pursue the Northern Option because of the outcome of preliminary findings of the impacts of the Northern Option, the negative benefit / cost, and the limited traffic benefits in terms of resolving traffic congestion along the existing Illaroo Road in the short, medium and long terms. Future growth plans currently envisaged under the Nowra Bomaderry Structure Plan would also have to be reassessed and this may mean that the Illaroo Road to Moss Vale Road Link Road may be at risk of not proceeding.

Environmental assessment of the North Nowra Link Road has identified that potential impacts can be acceptably managed and mitigated through:

- Avoiding direct impacts to sensitive environmental features through the detailed design of the road.
- Incorporating mitigation measures as part of the detailed design, including fauna crossing structures (such as arboreal ropes and gliding poles), and noise berms or barriers.
- Implementing best practice environmental management measures during construction.
- Providing ongoing management and protection of *Zieria baeuerlenii*, as well as investing in species propagation.

The North Nowra Link Road will require revocation of the Bomaderry Creek Regional Park. Offsets have been proposed which will more than compensate for the land to be revoked in terms of area, quality, habitat for threatened species, and amenity values for visitors to the Regional Park.

23.1 Ecological Sustainable Development

The principles of ecologically sustainable development (ESD) are set out in the Protection of the Environment Administration Act 1991, which are referred to by the Environmental Planning and Assessment Act 1979.

The ways in which the North Nowra Link Road Concept Plan responds to the principles of ecologically sustainable development are summarised in Table 23.1 below.

Table 23-1: Consideration of ESD Principles

ESD Principle	Concept Plan Approach
The Precautionary Principle	▪ Detailed environmental assessment has been carried out and will inform the selection of a route for the North Nowra Link Road. ▪ Environmental Risk Assessment has been carried out for each route option. ▪ Council has committed to meeting best practice environmental standards, goals and measures to minimise environmental risks.
Inter-generational equity	The objective of the North Nowra Link Road is to improve the local road traffic network, reducing congestion, lower overall network delays and car emissions, improve safety and amenity on Illaroo Road and provide addition emergency access into North Nowra, addressing current problems and providing spare capacity for future growth. This will provide the infrastructure required for continued growth of Nowra-Bomaderry in accordance with the NSW Government's South Coast Regional Strategy and the Nowra-Bomaderry Structure Plan.
Conservation of biological diversity	Detailed biodiversity assessment has been carried out and will inform the selection of a route for the North Nowra Link Road. Detailed assessment of the potential impacts to threatened flora and fauna species located in the and adjacent to the Bomaderry Creek Regional Park has informed the selection of biodiversity mitigation measures to be applied, and the selection of proposed offset lands. Council offers the proposed offset lands to be incorporated into the Regional Park improving the biodiversity values of the Regional Park by increasing the number of threatened species specimen within the Park and increasing the amount of known habitat for threatened species.
Improved valuation, pricing and incentive mechanisms	Environmental and social costs/benefits have been considered alongside economic and financial costs/ benefits in the assessment of the 3 route options for the North Nowra Link Road.

24.0 Conclusion and Next Steps

24.1 Conclusions

The Concept Plan seeks approval for a North Nowra Link Road. This Environmental Assessment Report provides detailed assessment and justification for the development.

The assessment was a multi-stage process involving initial consideration of how current and future traffic congestion in North Nowra can be resolved at a strategic level. A number of options were examined, from short term works to relieve immediate problems to long term solutions requiring further bridge crossings of the Shoalhaven River and potential bypasses to the east and/or the west.

The project is justified on existing traffic levels, but will become more urgent as traffic continues to grow. While future land releases will depend on detailed environmental assessments of each new area, the need for an improved road network is already apparent, technically justified and feasible, even without further land releases. Council has recognised this and has allocated funds to allow the immediate construction of the North Nowra Link Road, pending approvals.

The Environmental Assessment considered three routes for a proposed North Nowra Link Road. The objectives of the NNLR are to reduce existing traffic congestion in North Nowra, and on the Princes Highway at the northern end of the Shoalhaven River bridges, and to cater for future growth in the Nowra/Bomaderry region as outlined in the Nowra Bomaderry Structure Plan, which has been endorsed by the NSW Government.

All three of the short listed route options would affect sections of Bomaderry Creek Regional Park.

While in the longer term bypasses and additional crossings will eventually be needed in addition to the NNLR, in the short term only the following were found to be economically viable:

- The proposed Central or Southern NNLR route options.
- Improvements to the Illaroo Road/Princes Highway intersection.
- Improvements to the Bridge Road/Princes Highway intersection.

The Northern Option was not found to be economically viable. The NNLR Central and Southern Options were found to be economically viable in isolation, whereas the Highway improvements identified on both sides of the Shoalhaven River bridges were found to add considerable additional network benefits in addition to a NNLR. The construction of the NNLR however is the extent of Council's responsibility as a local road authority. The RTA is continuing its investigations into short, medium and long term improvements of the Princes Highway, which are likely to include the abovementioned improvements.

The detailed traffic and economic analysis has concluded that the road network proposed in the Nowra Bomaderry Structure Plan (including the construction of the NNLR Central Option in conjunction with MVRDLK and with Princes Highway capacity improvements) can be supported as a viable transport solution to address growth as envisaged under the Structure Plan, and would give considerable benefits to the North Nowra to Bomaderry local road network north of the Shoalhaven River including the Princes Highway.

In the long term, access from the Western Bypass to/from North Nowra and interchange at Moss Vale Road will also be required (in addition to the NNLR and MVRDLK) to contain traffic volumes on Illaroo Road to present day levels.

Traffic modelling has shown this would only be achievable with the Southern and Central Options.

The different corridors have different impacts because they have different capital costs, different traffic amelioration effectiveness and on-going transport costs, and different environmental implications.

The Northern Option would not meet one of the four key objectives for the project and is the least effective in ameliorating traffic congestion, as well as requiring elaborate noise control works. It was not found to be economically viable.

The Southern Option is the most expensive and involves serious issues with ecology and Aboriginal cultural impacts. It also requires elaborate noise control works, has a direct impact on the most pristine part of the Bomaderry Creek Gorge above the walking track.

The Central Option, while generally following a cleared services access road, has the greatest severance effect on the Regional Park. However based on a detailed analysis of the three route options the Central Option is the preferred option for the North Nowra Link Road. Overall it:

- Meets all of the project objectives.
- Ranks well on key and other issues, and has the fewest adverse rankings.
- Is the most economically viable.
- Results in the greatest shift of traffic to the link road in peak periods.
- Results in greatest reduction in VHT (lower overall network delays, emissions and ongoing transport costs).

The key issue associated with the Central Option is the impact on flora and fauna, however through appropriate design measures the adverse impacts can be acceptably mitigated. Council has considered ways to ameliorate the impacts of all three route options. However, on balance Council believes that a substantial enlargement to Bomaderry Creek Regional Park via the transfer of up to 50 hectares of adjoining Council owned land to DECCW is an appropriate way to offset the impacts of the Central Option. This is in addition to design and construction mitigation measures as well as on-going management and protection of *Zieria baeuerlenii* and investing in species propagation. Given that, Council wishes to seek Concept Approval for the Central Option from the Minister for Planning.

24.2 Next Steps in Assessment process

If the Department of Planning is staisfied that this Environmental Assessment Report generally addresses the Director-General's Requirements then the Department will place the assessment on public display for at least 30 days and it will invite public comment. During the exhibition period, any person will be able to make a submission to the Director General about the project.

The Director General will provide copies of all submissions to Council and to relevant public authorities. Council may be requested to respond to the submissions and may be asked to amend the project or Statement of Commitments where necessary to minimise, mitigate or manage predicted environmental impacts.

Should the project be changed, Council may be required by the Department of Planning to prepare a Preferred Project Report to document those changes. The Minister for Planning can also appoint an independent panel to advise him on any aspect of the project.

The Director General must then report to the Minister on the project. If approval is recommended, draft conditions of approval must be included. The Minister can then approve or disapprove the proposal, and in the former case decide what conditions will apply.

The Department will notify Council of the Minister's determination and will publish the Minister's decision along with the Director General's assessment report on the Department's web site.

24.3 Next Steps in Design Process

Council is applying for concept approval for only one corridor as a result of this Concept Plan application and Environmental Assessment. If the Minister grants that approval, Council will proceed to prepare detailed designs for an optimal road alignment within the selected corridor.

This may then lead to a further application to the Minister for Project Approval of the North Nowra Link Road to address in detail outstanding design issues and ensure that the detailed designs for the road are consistent with the Minister's Concept Plan approval.

List of Acronyms and Abbreviations

AHIMS	Aboriginal Heritage Information Management System
ALC	Aboriginal Land Claim
ARI	Annual Recurrence Interval
BCR	Benefit Cost Ratio
BCRP	Bomaderry Creek Regional Park
CBD	Central Business District
dB(A)	decibel
DBH	Diameter Breast Height
DECCW	NSW Department of Environment, Climate Change and Water
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (now the Commonwealth Department of Sustainability, Environment, Water, Population and Communities)
DGRs	The Director-General's requirements for the preparation of an EA
DNR	NSW Department of Natural Resources
DPI	NSW Department of Primary Industries
DWE	NSW Department of Water and Energy
EA	Environmental Assessment
EAR	Environmental Assessment Report
ECRTN	The NSW Government's *Environmental Criteria for Road Traffic Noise*
EEC	Endangered Ecological Community
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
ESD	Ecologically Sustainable Development
GBF	Giant Burrowing Frog
Ha	hectares
IRR	Internal Rate of Return
Km	kilometre
kV	kilovolt
$L_{A,eq}$	Equivalent continuous A-weighted sound pressure level
$L_{A,90}$	Sound pressure level exceeded for 90% of the time (taken as background noise levels)
LGA	Local Government Area
LOS	Level of Service
MVRDLK	Moss Vale Road Link (to Illaroo Road)
NLALC	Nowra Local Aboriginal Land Council
NNLR	North Nowra Link Road
NBSP	Nowra Bomaderry Structure Plan
NPV	Net present value
NPVI	Net present value per dollar of investment
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NPWS	National Parks and Wildlife Service (now part of DECCW)
REF	Review of Environmental Factors
RCR	River Crossing Relief
RTA	NSW Roads and Traffic Authority

SCC	Shoalhaven City Council
SIS	Species impact Statement
SLEP	*Shoalhaven Local Environmental Plan 1985*
TSC Act	*Threatened Species Conservation Act 1995 (NSW)*
VHT	Vehicle Hours Travelled
VKT	Vehicle Kilometres Travelled
VPD	Vehicles per day